TRAFFIC QUARTERLY

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APRIL 1954

City Traffic
Seattle's Crosstown Parkway
Would Zone Fares Help Transit?
District of Columbia Point System
Chicago's Off-street Parking Ordinance
Keeping Central Business District Strong
Traffic Related to Population and Distance
The Pittsburgh Redevelopment Program
A Canadian Parking Survey Résumé
Cycle Length and Signal Delay
Decentralized Retail Trade
Garden State Parkway

THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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City Traffic

TODAY we have an excellent means of private and commercial transportation. It has made a notable contribution to the country and has added to the usefulness and pleasure of our daily lives. Without it much that it does could not be done.

Most of the roads over which it necessarily travels lead to or from city boundaries. Within these limits many of the best roads become the worst. This condition leads to the commonplace: "I would not think of driving in the city," a curt summation of much of the public's idea of city driving.

The implications in this conciseness are many and far-reaching. To sum it up for the private driver, the inconvenience outweighs his tolerance. Its broader meaning to the city's healthy expansion, while as readily apparent, is not so easily summarized.

Modern transportation has so completely engulfed most cities that they are no longer able to profit from its advantages.

To them progress in transportation has become unendurable.

Their streets have become a network of confusion and congestion. They are laden with vehicles rapacious as wolves for space to move or a place to park.

To this bewilderment the pedestrian aimlessly adds his share, but with requisite determination accepts his risk.

This situation has not befallen cities in a day; its increasing seriousness has been observed and discussed over a period long enough to have warranted earlier bold measures. Today they are clearly faced with a near-insurmountable problem and desperate efforts to maintain a modicum of traffic circulation. These desperate efforts are of mixed value in that they often burden as much as they lighten the problem.

Responsible authorities over a long period have approached this dilemma with a degree of apathy and tolerance that can hardly escape reproval.

The earliest instances of traffic controls, then as now, clearly indicated a necessity for the integration of growing traffic volumes and

traffic-ways to carry it. Conditions that plainly focalized its destination and congestion were apparent. These important observations, timely analysis, and timely action went unheeded.

Today appropriate measures are not so simple nor so obvious. Though essentials are much the same, suitable solutions have become complicated and far more intricate.

It has been clearly and sufficiently demonstrated that the public is determined to make the most of highway transportation. How close they come to the full enjoyment of its potential will depend mainly on the provision of facilities.

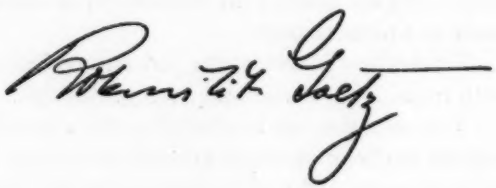
It recognizes the need for reasonable control, it prefers to drive with a minimum of necessary hindrance and inconvenience.

Sensible to the advantages of efficient transportation it expects sufficient ways to travel and park. It has convincing argument for these two inseparable necessities.

Faced with present conditions, these are not unreasonable expectations.

They warrant serious consideration in any well-planned and efficient city administration.

We must keep apace of progress in modern automotive transportation.



Maintaining the Health of our Central Business Districts

LARRY SMITH

Mr. Smith has served as a consultant for major shopping center and other real estate developments since 1918. He has been an adviser also to department store and chain store owners and to investment companies and mortgagees for thirty-six years.

IN DISCUSSING any problems or characteristics of a modern city, there is always danger of over-simplification. Factors in the growth and development of our cities are obviously complex. The effort to find a simple or comprehensive explanation of any single factor is likely to lead us to consider elements that appear to have the most important bearing on the problem and to neglect elements which may appear more remote. But because of the complex interrelationship these seemingly remote elements may have a greater influence on the problem than is apparent at the time of discussion.

Yet there is a corresponding danger of attempting to find new explanations for apparently new concepts, when a closer examination may indicate that the point involved is simply the old problem in a different guise.

The problem of decentralization has been talked about and written upon so frequently that readers may become weary and fear that nothing new can be added. On the other hand, the question comes up so often in connection with trends in our present-day cities that it cannot safely be disregarded. It is so large an element in the investment characteristics of commercial property, in our cities' traffic and parking problem, and in the merchandising and branch store problems of stores operating only a single branch unit, as well as the many chain store organizations characteristic of our commercial development in the United States, that any discussion which may lead to a better understanding of the situation is probably justified.

The term "decentralization" has been applied to so many different phenomena concerned with the changing character of our American cities, that it is important to attempt to define the term and at the same time to indicate as clearly as possible the current trend in our cities.

Decentralization or Diffusion

It is not necessary to complicate this discussion by presenting statistical confirmation of the fact that the United States has grown in population during the last fifteen years more rapidly than ever before. Predictions of responsible economists suggest that this growth rate is likely to continue for the next twenty years barring any serious decline in the level of business activity in the United States as a whole.

Accompanying this general population growth in the United States is a continuing trend toward increase in the proportion of urban population with a lesser growth or even a decline in the country's rural population.

	Total Population	*Urban Number—Percent.*	*Rural Number—Percent.*
1950	150,697,361	88,927,464 — 59.0	61,769,897 — 41.0
1940	131,669,275	74,423,702 — 56.5	57,245,573 — 43.5
1930	122,775,046	68,954,823 — 56.2	53,820,223 — 43.8
1920	105,710,620	54,157,973 — 51.2	51,552,647 — 48.8
1910	91,972,226	41,998,932 — 45.7	49,973,334 — 54.3
1900	75,994,575	30,159,921 — 39.7	45,834,654 — 60.3
1950	150,697,361	96,467,686 — 64.0	54,229,675 — 36.0

Source: United States Census, 1950.

The combination of these two influences has meant a rapid growth in cities of all sizes throughout the United States from the smallest with a population of a few thousand persons to our very largest cities.

This growth varies in degree. In some regions practically every

city is participating in a rate of growth greater than the national average. In other regions of the country, some cities are growing rapidly, others are growing slowly. The fact of city growth is almost universal and covers not only a growth in population, but in physical extent as new housing areas develop in the only place where it is possible for them to be placed, at the periphery of the city where vacant land is available.

Much has been made of the fact that the metropolitan areas of our various cities have recently increased at a rate faster than that of the cities themselves and that the growth outside of the city limits is usually much greater than the growth within the cities themselves. While true, this is simply a statement of the fact that city boundaries are ordinarily located at the limits of residential development. The inventory of undeveloped land within the city limits has therefore been insufficient to take care of the growing population during the last fifteen years. Under these circumstances development beyond the municipal boundaries took place from sheer necessity.

Based upon casual consideration of these statistics of suburban growth and upon consideration of the visual evidence of new, modern, attractive shopping centers with large parking areas attached in the suburban districts, there have been frequent statements that the phenomena referred to represent decentralization and will sound the death-knell of the central business districts.

Suburban Business Averages Compared

While complete statistical evidence is not available and while considerable research would be necessary before all factors could be considered and final judgment made, a substantial body of evidence available appears to indicate that the extent of retail merchandising in suburban areas in the average city in the United States of any particular size is not apparently greater than the proportion of such suburban retailing in cities of similar size over the last fifty or seventy-five years.

Complete records are not available by ordinary census data, but special studies made approximately thirty years ago indicate that the proportion of business done at that time in suburban areas in

cities of 750,000 population or over amounted to more than 65 per cent of the total retail business in the entire metropolitan area.

Analysis of the retail store areas in more than one hundred cities of the United States indicates that the percentage of retail development in the suburban community bears a fairly close relationship to the total population. The proportions between central and suburban districts seem to vary within reasonably close limits for similar size cities depending apparently upon location, rate of growth, and quality of the public transportation system.

In cities of fewer than 25,000 people this proportion may be 25 percent or 30 percent, representing largely the food, corner drugstore, and other very limited retailing in the residential suburbs. The percentage increases as the population increases and in typical cities of 500,000 population, we find that between 50 percent and 60 percent of the total retail space is located in the suburban communities at which time nuclei have been established at points of intersection of the public transportation system. Such nuclei contain variety stores, a limited number of apparel stores, hardware, and similar classifications of merchandise which almost characteristically throughout the United States are sold in major volume close to the place of residence.

	Metropolitan Area Population	*Total Retail Space 1952 sq. ft.*	*Retail Space in Central Business District sq. ft.*	*Percentage Central Business District*	*Percentage in Suburban District*
Wichita	194,047	3,826,000	2,076,000	54.26%	45.74%
St. Paul	361,017	5,558,000	2,909,000	52.34%	47.66%
San Antonio	449,521	7,368,000	3,525,000	47.84%	52.16%
Miami	458,647	9,756,000	3,035,000	31.11%	68.89%
Portland	512,643	8,285,000	3,542,000	42.75%	57.25%
Minneapolis	624,084	9,949,000	4,752,000	47.76%	52.24%

Source: Larry Smith and Company—Field Work.

In still larger cities the proportion of retail business in the suburban area increases to a considerable extent reaching more than 70 percent of over a million population.

	Los Angeles	*Philadelphia*	*Cleveland*
Population in Metropolitan Area	3,996,946	2,922,470	1,383,599
Percentage of Dollar Retail Volume 1948 Done in Suburban Districts			
Merchandise Categories			
Food	96%	95%	96%
Department Store	68%	36%	19%
Variety	78%	74%	62%
Apparel	77%	55%	46%
Furniture	87%	79%	75%
Hardware	98%	95%	94%
Drugs	87%	87%	87%
Eating and Drinking	86%	78%	78%
Other	72%	79%	73%
Total	86%	75%	71%
Percentage in Central Business District	14%	25%	29%

Source: United States Census.

It therefore appears reasonable to expect that as a city grows in size it will take on the characteristics of the larger city; and while complete evidence is not available, the presumption is strong that the growth of retail facilities in the suburban areas represents this normal development of suburban facilities which characteristically accompanies the growth of cities and their progression from smaller to larger populations, rather than decentralization of a character likely to harm the central business district.

Land Use Related to Transportation

The problems of land use and the distribution of retailing facilities between central business districts and suburban communities are related closely, although not solely, to the costs of transportation.

When used in the present sense, costs of transportation must be defined broadly. They include not only freight on merchandise handled in the stores, or delivery costs by truck; they also include the

cost of the customer's transportation to the selected locations as well as the relative cost of transportation for employees and suppliers of merchandise and services to the respective retailing centers.

A further variable of importance is the cost of land and buildings, and the broad cost of land and building must include the relative costs involved in the operation of old buildings normally located in the central business district and the possibly more efficient buildings developed in the suburban areas.

The location of any particular store, office building, warehouse, industrial plant or other facility will ordinarily be determined by selection of the site which offers the combination of such costs resulting in the greatest efficiency measured in dollars.

This pattern has been apparent for years. The *form* of transportation has changed for both merchandise and for persons. Determination of the final measure of convenience to the customers must include the value attached by the customers to their exposure to the greater choice of merchandise normally offered in the central business district. The weight attached to this greater exposure of merchandise is likely to increase with the level of prosperity.

Even in times of depression, however, evidence seemed to show that for many types of merchandise, the value attached by the customer to the availability of a wide selection of merchandise by variety and price levels was of greater comparative value than the cost of transportation measured merely by the financial cost of travel to the district in which such comparative values were being offered.

The Central Business District

The effect of this normal distribution of retail functions in our American cities cannot be considered intelligently without previous consideration of the functions of the central business district. The complex activities that have always been conducted at the focal point of our cities and of those in European countries where historical records go back farther than in our own country, represent not only the portion of retailing activities in which comparison of merchandise was the important factor, but many others which by their very nature can be conducted more efficiently in a central area—service

activities related to the business of the community as a whole: banking and advertising; the work of professional talent such as attorneys, accountants and architects; government offices, post offices, courts, personal service agencies including transportation terminals, amusements, laboratories, trade associations, etc.

This wide complex of activity is the justification for the central business district as well as the convenience of bringing together in one location those particular types of merchandising in which the availability of an adequate comparison or offering of merchandise is more important than the cost of transportation. Food and other types of merchandise in which comparison of values is not the important factor are characteristically bought close to the place of residence.

As civilization developed, the number of activities conducted in our cities increased rather than decreased. Specialized services have grown extensively and by their very nature have been located primarily in the central business district.

This is not to say of course that the central business district is the most important or the most convenient site for all types of business. It is obvious however that the central business district location is important for many types of business and is essential for a sufficiently large number to indicate that the central business district will remain and will thrive as long as our city structure continues in its present form.

Efforts are being pursued to plan more efficient cities in which these functions usually conducted in the central district can be dispersed with a saving in over-all costs of transportation. If a new form of city emerges, true decentralization could be the result.

As our cities grow in their present form, certain business functions and types of retailing can be conducted more conveniently in communities situated closer to the place of residence, when all factors including the cost of transportation are considered. The movement of these particular types of business and merchandising from the central business district is ordinarily accompanied by an expansion in the central business district of those particular functions which it is capable of providing more efficiently than any other location in the community.

Consequently, while the central business district's rate of growth is likely to be much slower, expressed in physical terms, than the growth of the retailing effort in the community as a whole, the changing emphasis in the various functions of the central business district and the increasing intensity of merchandising effort in the establishments located there give evidence of increased strength even though the physical manifestations of growth are more apparent in the suburban communities.

Parking in the Central Business District

Closely related of course to the cost of transportation problem over the last thirty years, has been the necessity for improved traffic arterials and terminal facilities for the private automobile in the central business district.

Some have argued that these parking facilities should be developed by private ownership and that the parking need can be measured in terms of the willingness of the individual to pay a fee for parking sufficient to justify the location of parking lots at convenient points throughout the central business district. We have been informed that profitable development of parking facilities in multi-deck structures has been accomplished on land costing more than $50 per square foot in the central business district of at least one of our American cities. The willingness of the customer to pay rentals justifying development of such property appears to give support to the theory that the parking need can be measured by the willingness to pay.

Conversely it has been urged that the provision of such private parking facilities cannot take care of the full needs of the community. It has been urged that the requirement for parking is a matter of importance both to the automobile owner and to the merchant or other business or professional man in the central business district, and as such the cost of providing these terminal facilities for parking private automobiles should be borne by the community at large.

It is apparent that the problem of terminal facilities for parking is similar to the problem of street improvement costs, both within

the central business district itself and the arterials leading from the residential communities to the central business district and to the suburban nuclei of shopping and business facilities. The entire problem of the cost of arterial development and the provision of terminal parking facilities must be explored further in view of the mounting expense of local and regional governments and the continually increasing use of the automobile.

Public Transportation Systems

The problem of traffic arterials and terminal parking facilities for the private automobile is closely allied with the problem of the public transportation system which appears to be one of the most important elements in maintaining the health of the central business district.

It is evident that in most cities of medium or large size, the consumers and employees who are moved by the public transportation system are as important to the health of the community as—possibly more than—the convenience of the owner who drives his private automobile to the central business district.

The concept of subsidizing public transportation appears to be considerably less popular than the generally accepted premise that improved arterials and parking lots should be provided at community expense. This attitude does not appear logical in view of the fact that the cost of providing facilities for the individual motorist who occupies street space for the movement of his vehicle with a single occupant, and the cost of providing parking facilities at ground level or in multi-deck garages for his entire shopping period or the entire business day are likely to be much greater than the cost of providing facilities for the user of the public transportation system.

Apparently some means must be found not only to maintain but to rehabilitate the public transportation system and enhance its relative attractiveness to the customer and employee, in comparison with the present-day convenience of private automobile transportation. This convenience must be measured not only in cost, expressed in dollars and time, but must be considered in light of the fact that the

automobile is likely to transport the individual from his own garage to a parking lot closer to his place of business or desired shopping location than the present form of public transportation.

Exploitation of Shopping Centers

The popularity of the decentralization concept, the rapid expansion of business, the problems of parking and public transportation in our central business districts, have led to a development of retail facilities within our metropolitan areas to a point which may not be justified by increased advantages to the retailer, the consumer, or to the city itself.

Modern shopping centers are logical adaptations to the automobile age of the characteristic suburban development at the intersection of public transportation lines forty to fifty years ago. To the extent that they represent such a logical adaptation and are related to population growth and the needs of the suburban community, they should prove a sound real estate investment and should justify their development by providing a satisfactory return to the entrepreneur.

The number of such centers, if the term is defined to include the neighborhood shopping communities headed by a super-market, is likely to total several thousand in the United States as a whole over the next ten to fifteen years. All available records of the development of suburban shopping communities over the last fifty years—including the period before the automobile was a factor in shopping as we know it today—suggests that such shopping or retailing centers in suburban communities were justified at the rate of at least one for each ten thousand of population. In a city like Detroit with a population today of approximately two and one-half million, there were at least two hundred fifty such identifiable shopping districts before the development of parking lots as we now know them.

In view of the anticipated increase in population of approximately forty million over the next twenty years, it seems reasonable to expect that there may be room for between 3,000 and 5,000 of this type of shopping center.

However, the number of shopping centers which can be justified decreases rapidly as the size of the center itself increases. There is no experience which would justify the use of any mathematical ratio between the number of neighborhood shopping centers headed by super-markets and the number of regional shopping centers headed by department stores.

It is nevertheless axiomatic by study of the extremely limited number of *major* shopping centers developed prior to 1940 as compared with the number of typical shopping districts for *neighborhood service* developed up to that time, that regional type shopping centers with department stores as the principal merchant are extremely few in number and are justified to only a fraction of the number justified for neighborhood service.

Notwithstanding the obviously limited opportunity for this type of project, dozens are being promoted in areas where the economic background does not justify such centers; they are also being promoted with planning characteristics that are not calculated to insure profitable operation for the merchants or convenient shopping for the customers.

Some of these projects are already proving unsatisfactory as investment material. It is likely that others will be similarly unsatisfactory.

Experience now becoming available covers the investment characteristics of the full range of shopping centers from the small neighborhood type with a food market as its principal tenant up to the full regional center including a major department store. This experience will permit a more intelligent appraisal of the relative merits of suburban developments and the position of the central business district.

Conclusion

1. There appears to be strong evidence that the manifestations of change in the characteristics of our American cities are related primarily to the growth of population and not primarily to decentralization as defined.

2. Evidence indicates that the cost of transportation and the cost

of land and building are the two principal factors in the trend and that these have been the principal factors in the trend for the last fifty years or more.

3. There is strong historical and logical indication that the central business district is holding its own and will continue to do so.

4. Notwithstanding this evidence, the attractiveness of new shopping centers as investments has led to entrepreneurial pressure for the development of new projects, supported by a favorable climate in which development of improving traffic facilities is being undertaken at public expense.

5. All interested in the city structure should examine closely the trends now apparent both new and old in determining the relative merit of our central business district and our suburban areas as a form of investment, as a place in which to do business, as a place in which to shop. They should also reconsider the responsibilities of the community for developing those new forms of transportation, whether public or private, calculated to provide the greatest efficiency and convenience to the community as a whole.

Sociological Relationship of Traffic to Population and Distance

FRED CHARLES IKLÉ

Mr. Iklé is a research associate at the Bureau of Applied Social Research of Columbia University. Born in Switzerland, he was educated at the University of Zurich and the University of Chicago. His primary field of research is urban sociology. Since 1950 he has been engaged in research projects concerning the social effects of bombing destruction in cities. Currently, he is also studying the mathematical relationships between distance and intercity traffic and communications on a grant from the Rockefeller Foundation. This year he joined the staff of the Rand Corporation in Washington on a half-time basis.

TRAFFIC engineers and transportation experts have always been faced with the practical problem of estimating the number of vehicles that travel on certain routes. To plan new highways or bridges, forecasts are needed about the volume of traffic to be expected on the new facilities.

Useful estimating formulas have been developed which rely largely on traffic data and statistical trends of the past. Frequently, particular formulas have been introduced for some immediate practical problem without further effort to test these formulas in other situations or to integrate them into a more general theoretical framework.

This article discusses some of the basic problems of such a theoretical framework for making traffic estimates. Traffic is part of the more general field of human interactions and relationships between communities. As such it is of great interest to sociologists and to economists specializing in the theory of location. Sociological knowledge about the way people interact with each other over distances should therefore provide a basis for a special theory on

Editor's Note: This study is based on a research project sponsored by the Rockefeller Foundation and undertaken at the Population Division of the Bureau of Applied Social Research, Columbia University. The project is still in progress, and it is hoped that solutions to some of the problems raised in this article can be reported on at a later date. The writer is indebted for research assistance to Mrs. Bonnie G. Loflin.

traffic flows. Some pioneering research has been done in this area but the field is very young, and many of its basic problems have scarcely been touched upon.

Analyzing Traffic by Trips

To approach the relation between traffic volume, population, and distance systematically, it is useful to analyze the composition of traffic by trips. Trips can be studied as a form of interaction between people so that the influence of the population factor stands out more clearly. However, people are not involved equally in all types of trips. To disentangle the influence of population upon traffic, trips must be classified into different types according to their origin, destination and purpose. Then it can be shown how the population factor influences these components of a trip. The following classification should be sufficient for this discussion:

A. Trips to transport people.

1) From a person's residence to the residence of another person (visiting).

2) From a person's residence to a workplace in the city or an institution (shop, church, school, theatre), or to a workplace in the open country.

3) From a person's home to a resort area or point of interest (sight-seeing).

4) Return trips and combinations or parts of the above three basic classes. (A trip might lead from the home to school, then to shops, to a friend's home, and back to the origin; or a trip with a certain vehicle might constitute only a fraction of the whole journey, e.g., by car from the home to the station and thence by train to the office).

B. Trips to transport goods.

1) From a source of raw materials (mine, farm, etc.) to a storage place, an institution (manufacturing, wholesale, or retail establishment), or a consumer (or place of consumption).[1]

[1] Some goods are transported to their final destination without ever being delivered to an

2) From a storage place or institution (manufacturing, wholesale, or retail establishment) to another storage place, institution, or consumer.

3) From a person's residence to another residence (e.g., moving of household goods).

The majority of all vehicles on overland routes as well as within cities transports people and only a small portion transports goods.[2] Hence, trips of type A are more important for estimating traffic than those of type B.

The analysis to follow will first determine the influence of sheer population size upon traffic volumes, starting out with that type of trip where this influence is most obvious and direct. Then the effect of distance can be considered and mathematical models designed to test various hypothetical functions representing this effect. Afterwards, the more indirect influence of population size upon all types of trip will be discussed, leading to the consideration of socio-economic characteristics apart from the sheer number of people. Finally, various complications and limitations of the relation between population, distance, and traffic volumes will be introduced.

The Effect of Population Size Upon the Frequency of Person-to-Person Trips

Let us first consider trips from one person's residence to the residence of another person (type A 1). We can study these trips between separated areas, such as counties, cities, or smaller units. It will simplify our discussion to mention cities only, but arguments apply to other areas as well. Thus, we can take any pair of two cities and ask what basic factors determine the number of trips between these cities during a given time period.

From common sense it is possible to introduce two factors: (1) the size of the two cities, and (2) the distance that separates them. The larger the city of origin, the greater is the number of persons

individual consumer (e.g., building materials for highway construction). The concept "institution" is admittedly rather vague here, but it will soon become clear to the reader why we use it.

[2] In 11 different traffic surveys examined, trucks amounted only to between 12 and 27 percent of all vehicular traffic. On Sundays this percentage was still lower.

who can take a trip from it; and the larger the city of destination, the greater is the number of persons to whom a trip might be taken. The greater the distance the less likely or less frequent is a trip.

It is possible to determine abstractly, without reference to empirical data, how the population sizes of the two cities jointly affect the frequency of trips of type A 1. Each such trip involves the relationship of a pair of people—one person in the city of origin who takes the trip, and one person in the city of destination to whom the trip is being taken. The greater the number of possible pairs, the more likely or the more frequent are relationships leading to a trip. The number of all possible pairs between two cities with population size P_1 and P_2, is equal to the product of the two populations, P_1 times P_2. Therefore, the combined influence of the population sizes of the two cities upon the frequency of trips is equal to this population product.

The Effect of Distance
Upon the Frequency of Trips

The effect of distance cannot be determined without empirical research. Distance affects the frequency of trips for two reasons: (1) the greater the distance, the greater the cost and time of traveling, and (2) the greater the distance, the less likely is an *actual* relationship between a potential pair of people leading to a trip; in other words, the farther apart people live, the less likely are they to know each other.

The first effect of distance would, in general, lead to an inverse-linear relationship so that the number of trips between two cities decreases with the reciprocal of the intervening distance. If a person has a certain amount of time or money available for traveling, he can take either a few long trips or many short trips; the number of possible trips will vary exactly inversely with their length.

The second effect of distance depends upon the social relationships which existed previously between the two cities and which initiate or motivate trips. Too little is known as yet about the genesis of interpersonal relationships. At the risk of over-simplifying the problem, we can imagine it as a three-step process. First, a social relationship originated in a chance meeting of two persons. Chance

meetings are more likely over shorter distances than over longer distances for the reason mentioned above: a person can take more short trips than long ones within a given time period. Second, once a chance meeting has occurred it is more likely to turn into a permanent relationship if the distance for repeated visits is short. Third, given the permanent relationship, we have again the time-cost effect of distance upon the frequency of trips mentioned in the preceding paragraph.

The frequency of trips between two cities is thus affected by the intervening distance not only because of the cost of traveling but also because the social relationships were previously influenced by distance. The effect of previous social relationships, or the "deposit of previous interactions,"[3] is difficult to study since we practically never have two cities whose populations are not already linked in many different ways. Some interesting data on the traffic-generating effect of the deposit of previous interactions can be found in the gradual increase in traffic over a new bridge which links two areas formerly separated. This induced or generated traffic of new bridges is well documented in traffic studies.[4] A new bridge brings two areas closer together and thus facilitates all three steps in the genesis of inter-personal relationships.

Simplifying assumptions have been made about the effect of distance upon the frequency of interactions. Generally, these assumptions disregard the deposit of previous interactions and give no rationale to make the suggested function of distance more plausible. The most commonly used assumption supposes that the function of distance is an inverse-linear one and that the number of trips between two cities is proportional to the cities' population product. This can be formulated algebraically by introducing the following symbols:

P_i = population in city i
P_j = population in city j
H_{ij} = number of trips between city i and city j during a given time period
D_{ij} = distance between city i and city j

[3] This term was suggested by Prof. Stuart C. Dodd.

[4] See, for example, George W. Burpee, "Traffic Estimates for Express Ways and Other Public Toll Revenue Projects," *Traffic Quarterly*, January 1953 (Vol. VII), p. 5; and George N. Lewis, Jr. and Walter C. Hopkins, "Chesapeake Bay Highway Bridge and Its Effect on Traffic," *Ibid.*, April, 1953 (Vol. VII), p. 178.

so that this hypothesis reads:

$$H_{ij} = k \cdot \frac{P_i \cdot P_j}{D_{ij}} \qquad \text{(Formula 1)}$$

The factor k is a constant needed only to adjust different dimensions. Since this is a statistical relationship involving proportionality a large number of city pairs is required to test it empirically.

The first to suggest this hypothesis were John Q. Stewart[5] and George K. Zipf.[6] Both applied this formula not only to traffic but also to other interactions, such as telephone calls, letters, and bank checks, for which they found interesting correlations. Probably the most thorough formulation of this relationship between population, distance, and the frequency of interactions was introduced by Stuart C. Dodd.[7] Dodd allowed for the fact that distance might enter in a more complicated way than the inverse-linear function. Based on Dodd's formulation, Joseph Cavanaugh carried out many empirical correlations.[8] However, his as well as Zipf's correlations do not allow the distance factor to assume any other but the inverse-linear function. They plotted the logarithms of the H_{ij} values against the logarithms of the $\left(\frac{P_i P_j}{D_{ij}}\right)$ values. In many cases an exponent q was then found so that

$$H_{ij} = k \cdot \left(\frac{P_i P_j}{D_{ij}}\right)^q \equiv k \cdot \frac{(P_i P_j)^q}{D_{ij}{}^q} \qquad \text{(Formula 2)}$$

We are left at a loss how to interpret this finding, because the expression $(P_i P_j)^q$ is meaningless in terms of pair-relationships. What we want to find, instead, is an exponent b, so that

$$H_{ij} = k \cdot \frac{P_i P_j}{D_{ij}{}^b} \qquad \text{(Formula 3)}$$

5 John Q. Stewart, "A Measure of the Influence of a Population at a Distance," *Sociometry*, V. 1942, pp. 63–71, and "Potential of Population and Its Relationship to Marketing," *Theory in Marketing*, edited by Reavis Cox and Wroe Alderson. (Richard Irwin, Chicago 1950), pp. 19–40.

6 George Kingsley Zipf, "The $\frac{P_1 P_2}{D}$ Hypothesis on the Intercity Movement of Persons," *American Sociological Review*, XI, 1946, pp. 677–686, and *Human Behavior and the Principle of Least Effort*. (An Introduction to Human Ecology) Cambridge, Mass.: Addison-Wesley Press, 1949, Chapter IX.

7 Stuart Carter Dodd, "The Interactance Hypothesis. A Gravity Model Fitting Physical Masses and Human Groups," *American Sociological Review*, XV (1950), pp. 245–256.

8 Joseph Aaron Cavanaugh, "Formulation, Analysis and Testing the Interactance Hypothesis." (Unpublished Ph.D. Thesis, University of Washington, 1950).

If this exponent b should assume the value 2, for example, we would then have an inverse-*square* relationship between traffic and distance, instead of the inverse-linear one which has been assumed so frequently.

This exponent b can be determined if we reformulate the hypothesis, so that

$$\frac{H_{ij}}{P_i P_j} \equiv k \cdot \frac{1}{D_{ij}{}^b} \qquad \text{(Formula 4)}$$

Using logarithms we obtain

$$\log \frac{H_{ij}}{P_i P_j} = \log (k) - b \cdot \log (D_{ij}) \qquad \text{(Formula 5)}$$

This is the equation for a straight line, hence b can be found by the least square method provided the correlation of the empirical data on city pairs is high enough.

By means of Formula 5 we calculated the exponent b for various types of interactions. So far no consistent pattern has been discovered. For example, for airline trips between twenty-nine major U. S. cities, b was found to be -1.07 (with a product-moment correlation coefficient $r = -.54$). For automobile trips between the central business district and other districts in Dallas, b was $-.689$ (with an $r = -.64$). For automobiles between Fort Wayne (or passing Fort Wayne) and counties in Indiana, b was as high as -2.57 (with an $r = -.96$).[9]

The Effect of Population Size Upon the Frequency of Different Types of Trips

Having thus illustrated that the relationship between distance and traffic is by no means uniformly inverse-linear (nor inverse-square) we will now examine whether we were justified in using the population *product* in lieu of some other possible function of the

[9] The source for the number of airline passengers between cities is a study by the U. S. Department of Commerce, Civil Aeronautics Board, *Airline Traffic Survey* (March, 1950). The source for the Dallas traffic data is the Traffic Survey of the Metropolitan Area of Dallas, Texas, conducted by the Texas Highway Department (1950–1951), and the statistics for Fort Wayne were kindly supplied by Mr. V. H. Pelz, Traffic Audit Bureau, New York. All these correlations involve various complications and statistical problems beyond the scope of this article.

city populations. We evolved the population product, P_1 times P_2, on the basis of abstract arguments for trips of type A 1 (pair-relationships). For other than person-to-person trips, however, the same arguments do not apply.

Let us therefore examine how population size might affect other types of trips. For trips type A 2 or A 3 (from a person's residence to an institution, workplace, or resort area) the number of trip origins is also directly proportional to the population size of the area of origin. But the number of trip destinations is only proportional to population size under certain conditions. The destinations are approximately proportional to population size if the area of destination is a whole city instead of a district within a city.

For a total city we can say that the larger its population the greater the number of work-places, shops, schools, churches, etc., located in it, and hence the greater the number of destinations for trips of type A 2 and A 3. Therefore the P_1 times P_2 formula again can be used. However, if our area of trip destinations is smaller than a whole city, or if it is a resort region or workplace outside of a city, then the number of destinations is obviously no longer proportional to the area's resident population.

This is the reason the estimating formula for intercity traffic cannot be applied indiscriminately to traffic between districts *within* a city. The downtown area, for example, contains many more destinations than its population size would warrant because so many institutions are located there.

The same reasoning can be applied to trips for the transportation of goods. Type B 3 trips (from a person's residence to another residence) are clearly proportional to population both in their origins and destinations. Trips of type B 2 are partly proportional to population, but the origins of type B 1 trips (sources of raw material) are not at all related to population size.

Thus, the estimating formula using the product of the population in the area of origin times the population in the area of destination logically applies only to certain forms of traffic. However, with respect to the large majority of all trips in intercity traffic, this population product accounts approximately for the influence of population size.

Some other studies have used the square root of the population product, $\sqrt{P_1 \cdot P_2}$, instead of the linear product.[10] This formula cannot be justified logically if one accepts our deductive arguments. According to one report,[11] the square root of the product yields empirically better results because it produces a closer fit in the logarithmic linear correlation. This correlation however is not comparable with our Formulas 1 or 3 because first, the traffic of several city pairs connected by the same highway was added together to obtain the *total* traffic along a certain route; and second, the slope of the logarithmic correlation is different from unity so that we obtain the dubious Formula 2.

Instead of using Formula 2, the data in this report should be rearranged so that Formula 3 or 5 can be tested. This was possible for only a very small portion of the data where origin-destination statistics were available.[12] For this set we obtained the following function

$$H_{ij} = k \cdot \frac{P_1 P_2}{D^{(2.6)}}$$

and the product-moment correlation coefficient $r = -.87$.

The Effect of Population Characteristics Upon the Frequency of Trips

Our formulas consider only the sheer numerical influence of population upon traffic, but obviously, the traveling habits of people differ widely. Income and occupation affect the frequency of trips a person takes. Therefore the populations, P_1 and P_2, should be weighted according to their social and economic characteristics. Yet before we know how to take account of distance we can scarcely approach these additional refinements. For research purposes we

[10] Robert G. Hennes, "Highway Classification in Washington," *Traffic Quarterly* (January, 1953), pp. 75–107, and William J. Platt, "Evaluating Intercity Air Traffic," *Air Transport* (September, October, 1946). The latter study does not compare the square root and the linear population product, but gives preference to the former for "dimensional" reasons. However, a better case can be made for the opposite argument that intercity traffic as a form of human interaction should have the dimension "population squared"; cf. Stuart C. Dodd, *Ibid.*, p. 254–255.

[11] "State Interest in Highways," a report by the Washington State Council for Highway Research (1952). This is the study underlying the article by Robert G. Hennes, quoted above.

[12] *Ibid.*, Vol. II, p. 252.

will do better by selecting our cases so that these disturbing factors of population *composition* are kept constant or randomly distributed.

An example of a weighting factor that has been successfully applied is car ownership. Since traveling by private car depends on car ownership, traffic estimates can be improved by taking the number of registered cars instead of the total population in a city. This is tantamount to weighing the population factors P_1 or P_2 by the percentage of car owners.[13]

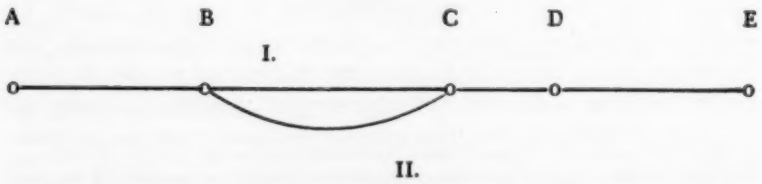
The Distribution of Intercity Traffic Over Routes

For highway planning purposes we not only wish to estimate the total traffic between two cities but we also wish to determine how this traffic is distributed over various routes. If only one route connects several cities, then we can obtain the traffic volume of a certain stretch on this highway simply by adding up the estimates on intercity traffic for those city pairs which are connected by this stretch. For example, if we have five cities A, B, C, D, E, connected by only one route I (Figure 1), and if we know the traffic for all city pairs AB, AC, AD, AE, BC, etc., then the total traffic on the stretch B–C is equal to the following sum of city pair traffic:

$$\overline{AC} + \overline{AD} + \overline{AE} + \overline{BC} + \overline{BD} + \overline{BE}.$$

($\overline{AC}$ signifies here the traffic from A to C *and* from C to A.)

FIGURE 1.



[13] The influence of population characteristics upon the frequency of airline trips has been studied by the Civil Aeronautics Administration in their publication *Airline Passengers* (Revised Edition, Government Printing Office, Washington, D. C., December, 1951). In this study it was found that marketing centers have more airline passengers per capita than industrial cities. The Civil Aeronautics Board used the population product as we proposed above, and for the influence of distance they simply took the inverse-linear function (according to our above-mentioned correlation analysis, the inverse-linear function is probably correct for airline traffic).

If there are two connecting routes (I and II in Figure 1) the problem becomes more complicated. The estimated total traffic between B and C has to be allocated to the alternative routes according to various criteria to obtain a traffic estimate for each route. Accessibility, speed, and low cost (no tolls) are some of the factors that attract traffic.[14]

Limitations of the Relationship Between Traffic, Population and Distance

Apart from the problems of alternative routes and differences in population composition (such as income and occupation) there are further complications in the relationship of traffic to population and distance. Especially important for this relationship are two limitations: (1) the range of distance for which a certain mode of traffic is appropriate, and (2) the "saturation" in a city's travel desire (or in the traffic volume emanating from a city).

A. The Range of Distance for Certain Modes of Traffic

Common sense tells us that certain forms of transportation are not used for very short or very long distances. Thus there is an upper limit in distance for walking, and a lower limit for plane trips. Hence the effect of distance upon the frequency of trips cannot be monotonically decreasing; in other words the frequency of trips of a certain kind per pair of people does not decrease over the whole possible range of distance. Our study of aviation data, for example, showed that the frequency of plane trips between cities in the United States (per pair of people) increases for the first 150 to 200 miles and then decreases approximately with the first power of the intervening distance.

B. Saturation

We have found that the frequency of trips between two cities increases with the population product of the cities and decreases as

[14] A method for allocating traffic estimates over different routes is proposed by Nathan Cherniack in "Measuring the Potential Traffic of a Proposed Vehicular Crossing," *Transactions of the American Society of Civil Engineers*. Vol. 106 (1941), pp. 520–576.

the intervening distance becomes larger (the more precise form of the distance function is still undetermined). Let us visualize a system of cities A, B, C, D of various population sizes P_a, P_b, P_c, and P_d at various distances D_a, D_b, D_c, and D_d from a central city Z. The people in city Z then travel to each other city A, B, C, D in accordance with our relationship of traffic to population and distance. The total number of trips taken by the people in Z will be

$$H_z = P_z \cdot P_a \cdot \frac{1}{f(D_a)} + P_z \cdot P_b \cdot \frac{1}{f(D_b)} + P_z \cdot P_c \cdot \frac{1}{f(D_c)} + P_z \cdot P_b \cdot \frac{1}{f(D_d)}$$

f(D) denotes the still unknown function of distance, e.g. D^b.

Since there are P_z people in city Z the average number of trips taken by one person in Z will be

$$\frac{H_z}{P_z} = P_a \cdot \frac{1}{f(D_a)} + P_b \cdot \frac{1}{f(D_b)} + P_c \cdot \frac{1}{f(D_c)} + P_d \cdot \frac{1}{f(D_d)} \quad \text{(Formula 6)}$$

By letting the cities A, B, C, D come closer to city Z (so that the volumes $\frac{1}{f(D)}$ will become larger) and/or by increasing their population sizes P_a, P_b, P_c, and P_d, the average number of trips taken by one person in city Z (the value $\frac{H_z}{P_z}$) would theoretically increase. However, it is obvious that there must be an upper limit to the number of trips a person can take within a given period of time. After this limit is reached the travel desire, or traveling capacity of city Z is *saturated,* so that the relationship between population size, distance, and traffic can no longer be applied to this situation, although it was found to hold true for other city pairs.

The phenomenon of saturation was first observed by John Q. Stewart on the frequency of trips to a resort area (the New York World's Fair).[15] Saturation can be easily analyzed if two simplifying conditions are met: first, that there are no competing pair-relationships (origin-destinations of trips), and second, that saturation occurs only at one pole of this relationship. These two conditions were met in the example cited above: first, only one World's Fair existed at the time, and second, while the potential visitors had a limited or saturable desire to take trips to the Fair, the Fair possessed an un-

[15] John Q. Stewart, "A Measure of the Influence of Population at a Distance," *loc. cit.*, pp. 70–71.

limited capacity to absorb visitors (unlimited for the practical case of out-of-state visitors considered here).

In most traffic situations, however, saturation is a more complicated phenomenon. Let us take, for example, type A 1 trips between cities (person-to-person trips). In this case saturation occurs at both poles of the origin-destination relationship: a person's desire in city A to visit somebody in city B is limited, and a person in city B has a limited capacity or desire to receive visitors. Furthermore, people in city A not only take visiting trips to city B alone, but also to all other cities, C, D, E, etc. If many cities in the system are close together and/or have large populations, saturation limits according to Formula 6 will be reached for many intercity relationships. Since the saturation limit imposes itself at both poles of the pair relationships and in interlacing summations, a mathematical formulation of it requires a most complicated theoretical model.

This problem of multiple saturation is not only of theoretical interest but also of practical importance for estimating traffic. For example, studies of airline traffic have shown that the number of airline passengers between two cities is lower than expected on the basis of their populations and distance, if another large metropolis is located nearby.[16] The traffic desire of the paired city is thus partly saturated by its traffic to the other nearby metropolis.

Practical Implications

Large sums are spent annually on traffic counts to develop estimates, and larger expenditures are involved in the construction of highways, bridges, airports, and other transportation facilities planned on the basis of these estimates. Each individual traffic estimate has to be based on practical knowledge and experience of the particular situation. Yet in spite of individual differences in a particular case, some general theory could be of great use in improving and facilitating concrete estimates. By analogy, the construction of each bridge confronts the engineer with problems that differ from all other construction tasks, yet he will use the general theorems of statics and mechanics to work out his particular solution.

[16] U. S. Department of Commerce, Civil Aeronautics Administration. "Intercity Airline Passenger Traffic Pattern" (June, 1950), p. 16 (mimeographed).

Considering the great expense at stake, it seems therefore justified to devote some effort toward the development of theoretical propositions concerning the flow of traffic and the relationships between cities. The problems mentioned here may appear quite remote from the practical tasks that face highway engineers and transportation experts, yet scientific theory has to be developed without being encumbered by too many practical considerations. The problem of traffic between cities is part of the more general sociological field of human interaction over distance. (Therefore intercity communications, like telephone calls or telegrams, can be approached with the same propositions.)

The development of a general theory greatly profits from practical findings if they are formulated so as to permit testing of certain hypotheses. In this respect traffic surveys and origin-destination counts could be improved. Out of two hundred traffic surveys we examined, only about twenty contained information on population size or car ownership in the origin and destination zones. In many instances the zones were ill-defined so that the theoretical factors which generate traffic could not be compared with the actual findings. It is hoped that this paper may stimulate more careful design of traffic surveys.

Would Zone Fares Help Transit Keep Its Riders?

NORMAN KENNEDY

Since 1950, Mr. Kennedy has been associate research engineer and lecturer at the Institute of Transportation and Traffic Engineering, University of California. Previously he was assistant professor of civil engineering at Syracuse University, and consultant to the Syracuse City Planning Commission. From 1938 to 1948 Mr. Kennedy worked in the Washington State Department of Highways. He is a registered engineer in the states of Washington and New York, and an associate member of the Institute of Traffic Engineers.

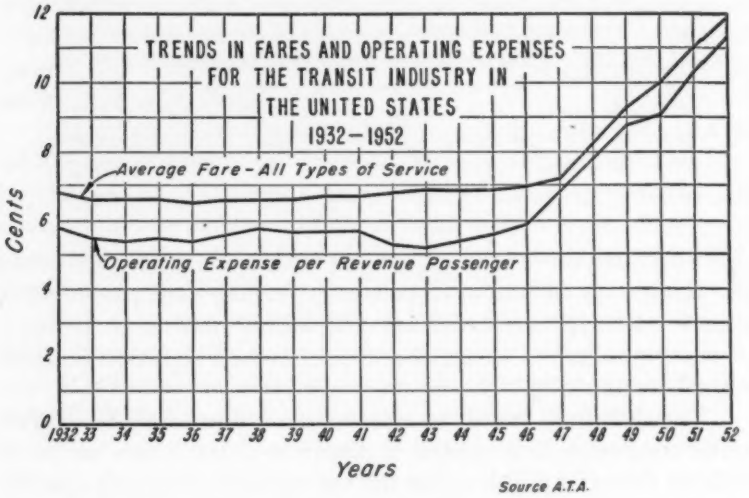
IN THE last seven years, the transit industry in the United States has lost 40 percent of its patronage, for the most part to automobiles. In 1946 transit carried 23.4 billion passengers; in 1953, about 13.9 billion. The rate of decrease has been an almost constant 1.4 billion annually.

The shift from transit to automobiles has not only intensified traffic congestion in the hearts of American cities; it also has posed difficult financial problems for the management of transit systems, whether publicly or privately owned. As transit patronage has declined, costs of providing transit service have relentlessly increased. Mounting costs might not have been cause for alarm if revenues had kept pace with costs. Unfortunately they have not.

Fares, the main source of the industry's revenues, have lagged behind the per-passenger operating expense. And even when increased they have sometimes failed to produce enough additional revenue to cover increased operating costs. Each fare increase has apparently caused a new decrease in transit riding, particularly during the off-peak hours. The result is that transit is left with a smaller total number of riders but with a higher percentage of them being carried in the peak hours.

The situation in which the transit industry in general finds itself today is similar to that faced by the street railway industry during

and after World War I. Then, too, patronage declined—the automobile and the jitney, later the bus, were already becoming serious competitors of transit—while costs of providing service increased. In 1919 the financial plight of the street railway industry as a whole was so grave that the Secretaries of Commerce and Labor asked the President of the United States to appoint a federal commission to study the problem.



Source A.T.A.

The President appointed eight men, representing various interests, to the Federal Electric Railway Commission. In July, 1920, the commission submitted its report. Among many possible means for improving the financial positions of street railway companies considered by the commission and its consultants was a drastic change in traditional American fare structure—replacement of the almost universally-used uniform flat fares with the zone fares long common throughout Great Britain and Europe.

Review of Zone Fares and Flat Fares

With the establishment of extensive street railway systems late in the nineteenth century, two types of fare structure came into use:

(1) the zone fare, or distance tariff, and (2) the uniform flat fare. While zone fare systems developed in Great Britain and Europe, uniform flat fares were common throughout the United States.

In the zone fare systems of British and European cities, transit lines were divided into comparatively short sections, or zones, and passengers paid fares according to the number of zones in which they rode. The theory was that everybody should pay the cost of service rendered and that this cost varied with length of ride. It was also thought that zone fares would stimulate short-haul riding.

The uniform flat fare policy of the American street railway industry was suggested by the slogan, "one city, one fare." All riders paid the same fare regardless of how far they rode.

In the early days of mass transit, when horse-railroad companies were organized to operate individual lines, a single fare ride was comparatively short; but when the horse-car lines were consolidated into single companies and electricity replaced horses as motive power, a great expansion of the uniform flat fare area took place. The one city, one fare policy involved not merely a uniform flat fare for all initial rides, but also the necessity of giving free transfers. As consolidated street railway systems expanded beyond city limits and in some cases reached out to combine the service of a group of cities covering a section of a state, it finally became impossible to extend the uniform flat fare to an entire area of service. Even so, the one city, one fare policy was preserved by making the uniform flat fare apply within the limits of a given city and its immediate suburbs. Only upon lines extending into the country or to other urban centers were zones established. Sometimes zones corresponded to city boundaries and sometimes they were on a mileage basis.

Why the uniform flat fare system was adopted by the consolidating street railway companies in this country in preference to the zone fare system used by their European counterparts is not entirely clear. Perhaps the explanation is simply that in the formative years of American street railway companies there was no need for any other kind of fare system. To begin with, the almost universal five-cent fare brought ample revenue to most companies when practically all urban travel was by street car. In addition, some street railway operations were carried on as incidents to some other business, such

as real estate. Street car lines were extended into unpopulated areas that had been purchased and subdivided by a street railway company in anticipation of profit depending upon sale of lots, not necessarily upon carrying passengers on street cars.

Reasons for Flat Fare System

For the street railway industry in general, the hope of the uniform fare as a continuing revenue producer was based on the expectation that as street railway systems expanded and the number of long-haul passengers increased, there would be corresponding, or even greater, increases in the number of short-haul riders. The loss incurred in carrying long-haul passengers at less than the cost of service would be offset by the gain in carrying short-haul riders at more than the cost of service. But apparently there was no widespread interest in the question of how far a passenger could be carried for the five-cent fare.

If in the early years street railway companies did not need to concern themselves with how far a passenger could be transported for five cents, changing conditions during and after World War I forced some to re-examine their fare structures in consideration of this question. The street railway industry, together with the Federal Electric Railway Commission, began to give attention to zone fares, and debated the relative merits of zone fares and flat fares.

Arguments advanced in support of the long-established flat fares were principally these: (1) that all passengers were treated alike since all paid the same fare; (2) that flat fares encouraged desirable residential expansion into suburbs (it was argued that with zone fares, workers would tend to live within the single-fare zone of their work); and (3) that flat fares were simple to understand and easy to collect.

The first of these arguments was countered with the view that all passengers were not treated alike, because those who rode short distances paid much higher per-mile rates than did those riding longer distances; it was pointed out that steamship lines and railroads charged fares in accordance with distances traveled.

The second argument for uniform flat fares was countered with the claim that flat fares had contributed little to the spreading out

of population, that the zone fare systems in Great Britain and Europe were not to any appreciable extent responsible for congestion of population in their cities. Congestion existed long before the street railways appeared and was brought about originally by limitations placed upon city expansion by walls erected for military purposes.

The third argument was readily accepted; it was admitted on all sides that zone fares involved some difficulties in fare collection for the railway companies. (Proponents of zone fares claimed that these difficulties would not be serious except for the American habit of over-crowding the street cars, which during the rush hour sometimes had twice as many people standing as sitting).

In spite of the difficulties in zone fare collection, some street railway companies in 1920 devised and inaugurated zone fare plans. A few were short-lived, and one zone fare trial ended in what a transit consultant described as little short of disaster.[1] (It is of interest however that the railway company involved in the unsuccessful experiment a few years later tried a zone fare system which, although modified over the years, is still in use.) A 1926 publication of the American Electric Railway Association, predecessor of the American Transit Association, listed more than sixty street railway companies—many providing principally interurban transit service—which had adopted zone fare systems, and five companies which had abandoned zone fares in favor of flat fares.

Among the street railway companies which successfully inaugurated zone fare systems in the post-World War I period were the predecessors of today's San Diego Transit System in San Diego, California, and United Transit Company in Providence, Rhode Island. Some adjustments have been made in the zone fare plans of both transit companies as populations have shifted, and operating conditions have changed; but the essence of the plans has been retained without change—fare related to distance traveled.

Some Recent Zone Fare Plans

In this post-World War II period of declining transit patronage, zone fares are again being seriously considered as a means of retain-

1 Wilcox, Delos F. *Analysis of the Electric Railway Problem*. New York, N.Y.: Author, 1921, p. 231.

ing riders, and some transit companies have adopted them. In fact, the use of zone fares is now more widespread than is perhaps realized. In the summer of 1953, about 160 transit companies in the United States and Canada were using zone fare systems in some form. Many of the companies however provide interurban or suburban service, and zoned transit lines extend beyond the boundaries of municipalities.

Among transit companies which have recently adopted zone fare systems are City Bus Company in Oklahoma City; Cleveland Transit system, and Indianapolis Railways, Inc.

City Bus Company, Oklahoma City

City Bus Company provides transit service to a metropolitan population of about 325,000 living in Oklahoma City and its immediate vicinity. Like other transit companies, City Bus Company has lost a substantial volume of patronage since 1946, while costs of operation have continued to increase. In an effort to maintain revenue, the company increased its flat fare four times between 1946 and 1950. The last of the increases raised the fare from ten to fifteen cents, or two tokens for twenty-five cents. In the fiscal year following, 1950–51, the company's patronage declined about 28 percent.

Oklahoma City's population density is only about one-half the average for other cities of approximately the same population. Because the city's population is so widespread, City Bus Company must operate three times[2] as much route mileage to serve the same number of people as United Transit Company does in densely-populated Providence. Most of the residential growth in Oklahoma City is taking place in sections five to eight miles from the downtown business district.

In an effort to arrest the downward trend of its passenger traffic as well as to make feasible some extensions of bus routes into outlying areas, City Bus Company turned to consideration of zone fares in 1951.

An origin-destination survey of all passenger traffic on the com-

[2] Simpson and Curtin. *Report on Zone Fare Structure for Bus Routes Serving Oklahoma City*. Based upon traffic survey conducted by Oklahoma City Traffic and Transportation Commission and City Bus Company. Philadelphia, Pa.: 1951, 9 pp., tables.

pany's routes, made in mid-July 1951, revealed that 75 percent of the total passengers carried began *and* ended their journeys within four miles of the downtown district. Slightly more than 15 percent of the total passengers made some portion of their journey within four miles of the downtown area, and fewer than 10 percent traveled only in the area beyond the four-mile limit. The average length of ride, the survey showed, was 3.02 miles, with individual trips ranging from less than half a mile to a little over thirteen miles.

Under the flat fifteen-cent fare, a few long-haul passengers traveled for rates as low as one cent per mile, whereas the average rate was 4.2 cents per mile, and some short-haul passengers paid twenty-five cents per mile. Deciding that its flat fare system was highly discriminatory against the short-haul rider, the company devised a zone fare system effective on January 15, 1952.

Four zones were established. The inner zone is diamond-shaped, extending outward from the heart of the city two and a half route miles in each direction. Zones 2 and 3 extend four and five and a half route miles respectively from the center of the city, and Zone 4 is beyond.

The fare is ten cents for a ride wholly within any one zone. Five cents additional is charged for each zone entered, with a maximum fare of twenty-five cents for one continuous ride. Zone 1 is in effect divided into subzones, and the fare for a ride entirely within Zone 1 but extending across the downtown business district is fifteen cents.

From information obtained in the origin-destination survey, the company and its consultants estimated that under the zone fare plan 40 percent of the passengers would pay single-zone fares, 35 percent two-zone, 19 percent three-zone, and 6 percent four-zone fares. No studies have been made since the plan was put into effect to check the estimates, but in late September, 1953, the assistant general manager of City Bus Company stated that the company was satisfied with the zone fare system.

Cleveland Transit System

Cleveland Transit System serves an estimated total population of 1,262,000 residing in an area of 135 square miles. It has developed a

somewhat different concept of zone fares, based on types of service rendered passengers as well as distances they travel. Called a "Zone Service Plan," it now includes three types of service: (1) a downtown loop service for a ten cent fare; (2) a "local" service for fifteen cents, and (3) an express service for twenty cents.

The downtown loop service is correlated with the successful operation of fringe parking lots.[3] But the success of the loop service is not attributed solely to its use by fringe parkers. The low fare and frequent service attract many short-haul riders—shoppers, business and professional people, messengers, and others—who are willing to pay ten cents, but probably not fifteen cents, to ride relatively short distances rather than walk.

On transit lines extending beyond the downtown area, Cleveland Transit System offers its patrons two types of service, local and express. Some of the longer lines have been divided into two parts, and on the inner part—the one nearer the downtown area—local service is provided with trolley coaches or buses which are turned back when they reach their outer terminals. Operating on the same street or on a nearby parallel street are other buses which run express through the inner "local service" area. Beyond the outer terminals of the local service lines, the express buses provide local service.

The fare for local service is fifteen cents; for express service, twenty cents. Transit riders who journey across the boundary between local service and express service have a choice as to which they will use. Those inbound towards the city from points beyond the outer terminals of the local service lines may pay fifteen-cent fares and then transfer without additional charge to a local service vehicle at its outer terminal. Outbound passengers who do not wish to pay the twenty-cent fare for express service may board a local service vehicle in the downtown area, pay a fifteen-cent fare, and at the outer terminal of the local service line transfer without additional charge to an express bus to continue the outward journey.

Few passengers choose local service instead of express to save five cents. The introduction of express service at premium fares has

[3] Described by Donald C. Hyde, general manager of Cleveland Transit System in *Traffic Quarterly*, July, 1953.

in effect increased the fare paid by almost all long-haul passengers.

Cleveland Transit System regards its zone service plan as an easily administered method for establishing an equitable fare structure which recognizes the difference in cost between carrying short-haul and long-haul passengers. The problem inherent in zone fare systems based solely on distances that passengers are carried—the identification of passengers for fare collection—is overcome in the zone service plan.

Although Cleveland Transit System suffered some loss of patronage in 1953, the decline from 1952 riding is less in Cleveland than in other cities of comparable size. For the first eight months of 1953, the number of passengers carried by Cleveland Transit System was 2 percent less than the number carried in the same period in 1952. For cities of the same population group, the average decline was about 6 percent. In the transit industry as a whole the 1953 patronage is about 7.6 percent under that of 1952.

Indianapolis Railways, Inc.

Indianapolis Railways, Inc. serves an estimated total population of 445,000, residing in an area of about sixty square miles.

In November 1952, Indianapolis Railways, Inc. asked the Indiana Public Service Commission for permission to replace its flat fare structure with a zone fare system. Following public hearings, the commission on May 7, 1953 gave Indianapolis Railways authority to try zone fares for a trial period ending November 1, 1953. On October 29th, the commission, in an order making the zone fares permanent, noted that the zone fare plan appears to be satisfactory "to the petitioner (Indianapolis Railways, Inc.) and all other parties."

In its interlocutory order authorizing the zone fare trial, the commission stated:

"The proposed zone fare structure is a departure from Petitioner's previous history of establishment of a flat fare for service, regardless of length of ride. The Commission finds that such a fare structure has become inequitable to the short-haul riders and that the proposed fare structure will give some necessary recognition to

the increased cost of service incurred for the long-haul passengers without placing any additional burden on the short-haul passengers."

The system consists of two zones. The boundary between zones is a circle with a radius of two air miles from Monument Circle, in the heart of downtown Indianapolis. The fare is fifteen cents for a single zone ride, twenty cents for two zones. Fifty-five percent of the riders pay single zones fares, 45 percent two-zone.

The success of Indianapolis Railways' zone fare plan is seen in its effect upon operating revenues which for the four-month trial period were $83,400 higher than for the same period of 1952. And although Indianapolis Railways, Inc. showed a net loss, after fixed charges, of $34,400 for the trial period, the Indiana Public Service Commission noted that $84,600 for amortization of property abandoned when street car operations were discontinued in January 1953, was included in total operating expense. Except for this amortization charge, the commission said, the operations would have shown a net profit of $50,300 for the trial period.

The question of whether or not zone fares would help other transit companies to retain patronage—and maintain satisfactory financial positions—cannot be answered solely from the experience of City Bus Company, Cleveland Transit System, and Indianapolis Railways, Inc. Local conditions—geographical, topographical, distribution of population, etc.—might be such that a transit company could not devise a practical zone fare plan. But apparently these three transit companies, along with others, have demonstrated that the long-standing principal argument against zone fares, the problem of fare collection, is not insurmountable. With flat fares at twenty cents in at least nine large metropolitan areas (sixteen cities including seven under 100,000 population had twenty cent fares July 1, 1953) some concerned with transit's problems express the view that the point of diminishing returns in flat fares may have been reached and that zone fares must supplant them. Apparently the management of Seattle Transit system, which now has a twenty cent cash fare, or three tokens for fifty cents, shares this view because it is considering the adoption of a zone fare plan in 1954 "to produce more revenue than is obtained under the present flat fare plan."[4]

4 "Zone Fare System Likely Next Year in Seattle," *Passenger Transport*, v. 11, No. 34, December 18, 1953, p. 2.

Harrisburg Railways Company is waiting for the Pennsylvania Public Utilities Commission's approval of a zone fare plan which the company devised as being in the best interests of both the company and its patrons. The plan is similar to that used by City Bus Company in Oklahoma City.

Zone fares have been used successfully by a few American transit companies for thirty years or longer. Their more recent use as a method of retaining transit patronage, or at least of retarding the rate of its decline, have proved to be satisfactory to the companies trying them.

Pittsburgh's Redevelopment Plan

PARK H. MARTIN

Mr. Martin is executive director of the Allegheny Conference on Community Development, a privately financed citizens' organization for planning and advancing a comprehensive development program for the City of Pittsburgh and Allegheny County. For more than twenty years he was engaged in the private practice of engineering in Pittsburgh. He is a registered professional engineer in the State of Pennsylvania. In 1933, Mr. Martin became chief engineer and assistant director of the County Department of Public Works, and later was appointed director of the County Planning Department. During this period and until 1945 when he became Conference director, he was in charge of planning and directing the construction of many major improvements in Allegheny County, including the new Greater Pittsburgh Airport and the Penn-Lincoln Highway project. Mr. Martin is chairman of the technical advisory committee of the Pittsburgh Public Parking Authority, a member of the City Planning Commission, and of the Urban Redevelopment Authority, in addition to serving in many other civic organizations. He is a member of the American Society of Civil Engineers, the American Planning and Civic Association, the Urban Land Institute of America, and a director of the American Society of Planning Officials. He has appeared on many national programs devoted to engineering and planning, and has contributed articles to official publications in these fields.

MANY articles have set forth the "Pittsburgh Story." Often in dramatic vein, they have emphasized personalities. This article, recognizing the value of persons in planning and carrying out the program, emphasizes how the program was developed, what was accomplished, and how the program was financed.

Pittsburgh lies at the center of Allegheny County. Within the corporate limits of the city are fifty-four square miles and 676,000 persons. The County of Allegheny contains 745 square miles and a

In an article titled, "Pittsburgh's Parking Authority," in the October, 1953 *Traffic Quarterly* of the Eno Foundation, William R. B. Froehlich concludes, "But newly-proud Pittsburghers like to point out that this entire parking authority activity is merely one facet of the gem that is gradually being cut from old Pittsburgh through its remarkable program redevelopment." This article sets forth other facets producing the "New Pittsburgh."—The Author.

population of 1,515,000 persons, 1950 census, including Pittsburgh.

Within the limits of the county are 129 separate muncipal subdivisions. A County Planning Commission operates in a very limited field; an effective Pittsburgh City Planning Commission operates inside the city limits, with some other municipalities having local planning commissions. The State Department of Highways and the County of Allegheny are responsible for the major highway routes and most secondary highways.

The Pittsburgh industrial area is known for its heavy industry. Because of this, and its having been founded in part on the great bituminous coal fields in the region, Pittsburgh acquired a rather unsavory reputation for smoke and dirt. Its traffic problems were mounting, the parking problem had not been tackled, a new airport was badly needed, assessed valuations in the city had declined from a high of $1,211,867,000 in 1936 to a low of $961,000,000 in 1947, with the Golden Triangle showing a higher rate of decline, all of which had become a matter of grave concern to its business and political leaders. Toward the end of World War II they decided it was time somebody did something about the situation.

A Conference on Community Development

As a first step it was agreed to form a citizens' organization to be concerned with the future of the region. Known as the Allegheny Conference on Community Development, its purpose was also to stimulate and coordinate research and planning, looking to a unified community plan for the region as a whole. The conference by educational means was to secure public support of projects approved by the conference as parts of the over-all unified plan, and to see that something was done to bring about the fulfillment of the plans. Where qualified agencies existed the conference turned to them for research and planning assistance. In certain fields, where no such qualified agency existed, the conference created its own staff for research and planning. Committees composed of qualified persons were formed to study various phases of the community's needs and to make recommendations in relation thereto.

Emphasis has been placed upon the "Golden Triangle." Formed

by the confluence of the Allegheny and Monongahela Rivers, the Triangle covers 330 acres, of which seventy are streets. It is the business and commercial heart of the city and county; its assessed valuation represents about one quarter of the assessed valuation of the entire city. The need to preserve and protect the stability of the triangle was recognized and accepted, and the great emphasis on this area was deliberate. While the county grows in the suburban areas, both residentially and commercially, the central core, it is believed, should be preserved.

This emphasis on preserving the values in the Triangle is further recognized in the highway program and mass transit studies.

A Comprehensive Program

It was our feeling in the conference that a community improvement program must be broad and balanced. With that in mind, we have been concerned with smoke and flood controls, highways, parking, airports, mass transit, sanitation and public health, recreation and conservation, zoning and urban redevelopment, libraries and other cultural matters, and economic development.

The order in which these subjects are treated does not classify their importance, except for smoke and flood control. Without those two projects, the entire program might have failed.

Smoke Abatement

Since the turn of the century, Pittsburgh worried about smoke control. In 1911, the state legislature passed enabling legislation to permit Pittsburgh to control smoke from all sources, but powerful opposition and civic lethargy blocked all efforts to pass an ordinance. Then in 1941, the city council did pass an effective smoke control law. Because of the War, the effective date of the ordinance was not set. In 1946, with conference urging and support, the council fixed the date as October 1, 1946, requiring industries and railroads to burn solid fuels smokelessly or use other types. On October 1 the following year, households within the city limits came under the provisions of the ordinance.

Six years of a fully effective ordinance have produced amazing

results in this heart of the bituminous coal industry. Official figures of the United States Weather Bureau show that today Pittsburgh is receiving 69 percent more sunshine. Soot and dustfall records reflect a reduction of 60 percent for the period of 1938–1952, years of high industrial activity. In seven years—1946–1952—the hours of heavy smoke as compiled by the Weather Bureau have been reduced by 93 percent. As a result of smoke control, building owners and managers in the Triangle alone have spent more than $1,500,000 on exterior building cleaning, and other office building cleaning projects are planned.

The benefits of more sunshine and cleaner living have extended to all of Allegheny County. In 1949 the board of county commissioners enacted a county-wide ordinance that embodied the principal features of the Pittsburgh ordinance. To date industry in Allegheny County has spent more than $200,000,000 in advancing smoke control. The installation of modern combustion equipment, dust collectors, new boiler plants, precipitators, and other modern devices are contributing immensely to the elimination, reduction, and control of smoke and other industrial pollutants.

Dieselization on the railroads has practically solved the problem of railroad smoke. Now railroad operations throughout Allegheny County are 81 percent dieselized; yard operations 91 percent. Even the colorful, smoking, stern wheel river boats have largely been discarded for diesel power, and now these operations are 78 percent dieselized.

The result of the smoke control program in Pittsburgh and Allegheny County is all the more remarkable because of the fact that this center of heavy industry consumes about 50,000,000 tons of coal annually.

Flood Control

In 1936 a disastrous flood hit Pittsburgh and the Upper Ohio Valley. Flood crests from the Monongahela and Allegheny Rivers converged at the Point, flooding the lower part of the Triangle with a depth of about ten feet. Property damage in the Pittsburgh District reached $94,000,000, and in the Upper Ohio Valley approximately $200,000,000.

Since 1936 the Federal Government through the United States

Corps of Engineers has constructed a $100,000,000 flood control system in this region. Eight major dams have been erected in the watersheds of the Allegheny and Monongahela Rivers, and all are now in operation. If the dams had been in operation at the time of the 1936 flood, the United States Engineers estimate the flood level at the Point would have been reduced ten and one-half feet.

Stream Pollution Abatement

Sixty municipalities in Allegheny County have entered into agreement with the Allegheny County Sanitary Authority to design and construct a system of collector sewers and a disposal plant. Substantially all of the sanitary wastes of these communities are disposed of, untreated, in the rivers. Industrial wastes will also be treated. The design plans will be completed in early 1954. Construction work will begin when the interest rates of Municipal and Authority bonds are more conducive to satisfactory financing.

Triangle Redevelopment

The Allegheny River flowing down from the northeast joins with the Monongahela River flowing in from the southeast to form the Ohio River, near the geographic center of Pittsburgh. The area lying between these two rivers and extending a mile east from their juncture is the Triangle—the heart of the business and commercial life of Pittsburgh and Allegheny County as well as the hub of the highways and transportation systems serving them. It is also the regional and metropolitan center of a tri-state area of more than 4,000,000 people and is one of the most compact central business districts in the country.

The area at the juncture of the Allegheny and Monongahela Rivers is known as The Point. This was the site of Fort Duquesne and Fort Pitt, and here the city was founded. To preserve the site of the two forts, the state is constructing an historical park of thirty-six acres. Started in 1945 this project is being financed entirely by the commonwealth and to date it has already spent more than $7,500,000 in land acquisition alone. All the buildings in the area

were razed; grading and landscaping were undertaken. Construction of a river wall around the park is also in progress.

In the park area an elaborate traffic interchange will be built to connect Fort Pitt Boulevard along the Monongahela, and Fort Duquesne Boulevard along the Allegheny with the street system in the Lower Triangle. Two double-deck bridges across the rivers will be built by the state. The state requested the Allegheny Conference to represent it in the development of plans for the park and to coordinate local interest. The conference has accepted.

In addition to initiating studies on the Park project, the conference also studied the adjacent area. This area of twenty-three acres was largely run down as a result of encroaching blight, railroad yards, and loft buildings. The conference evolved a plan to redevelop the entire area. In July 1946, conference representatives presented the plan to the Equitable Life Assurance Society of the United States with the request that the society become the redeveloper.

It was apparent from the beginning of negotiations, that to acquire the land where so many different owners and relatively small parcels of land were involved, the power of eminent domain would be essential. At this time Pittsburgh did not have an urban redevelopment authority. The conference recommended to the city council that such an agency with the power of eminent domain be created, and on November 18, 1946, the Urban Redevelopment Authority of Pittsburgh was established by action of the mayor and city council.

An essential step in the urban redevelopment process is the certification of an area as subject to redevelopment by the city planning commission. After thorough studies the city planning commission certified the entire area of both the proposed 36-acre park and the 23-acre adjoining property subject to redevelopment. The Urban Redevelopment Authority acted as the land-assembler of the 23-acre tract, and entered into an agreement with Equitable Life Assurance Society to be the redeveloper. The plan provided for complete readjustment of the street pattern and the initial construction of three large office buildings with only about 15 percent land coverage, with off-street loading and parking.

Leading Pittsburgh corporations signed long-term leases with Equitable Life to occupy space in these new buildings. These agreements were executed in February, 1950 by several corporations, a national bank, and a utilities company. These agreements were negotiated before all the land had been acquired in Gateway Center and before the buildings were completely designed. Two twenty-story buildings and one twenty-four-story building were completed. Equitable's investment in Gateway Center to date is approximately $43,000,000. Occupancy began in the spring of 1952.

Gateway Center provides for open space around the buildings, creating—in effect—an extension of Point Park. The city has widened and relocated Liberty Avenue as part of the project, and certain other thoroughfares in the area will also be widened and relocated; others have been vacated. The ultimate plan for Gateway Center provides for additional structures, including an open-deck parking garage. One existing garage has already been enlarged by the addition of one story, providing a total capacity of 600 cars.

Highway Program

A far-reaching highway program is underway in Pittsburgh and Allegheny County.

The Penn-Lincoln Parkway—the biggest single highway project ever undertaken in this area— is a major controlled access highway which will carry routes 22 and 30 into and through the Triangle. Twenty-seven miles in length, 9.5 miles of which are east of the Triangle, the Parkway provides a direct east-west highway through the city and county.

Four and six lanes divided, it has two twin-tube tunnels. One known as the Squirrel Hill Tunnel is now completed, and the other under what is known as Mt. Washington, not yet built. Squirrel Hill Tunnel is 4,225 feet long. The tunnel under Mt. Washington will be a few hundred feet shorter. When finished, the Penn-Lincoln Parkway will have sixteen points for entrance and exit. Seven miles of the eastern section of the Parkway were opened for travel in June 1953, and in October nine miles of the western part of the Parkway were opened for public use.

The entire Penn-Lincoln Highway project will cost more than $125,000,000 when completed. While the project is a non-toll highway, it is proposed to build the Mt. Washington Tunnel as a toll project. A tunnel authority is engaged in planning and designing this tunnel. Users of the parkway who prefer not to pay tolls may use the alternate Saw Mill Run Boulevard By-pass. Completed about a year ago, this is a four-lane divided, limited-access road that passes around Mt. Washington. Most motorists probably will prefer the tunnels to save time and distance.

Other major four-lane divided highway projects that have either been completed or are in the process of design are—McKnight Road; Sharpsburg-Etna Highway; Ohio River Boulevard, Pittsburgh Extension; and the Crosstown Thoroughfare. Numerous other lesser highway projects have been constructed. Four new major river bridges have been completed by the state or county in the last several years: Tarentum, Elizabeth, Rankin, and Dravosburg, representing over $27,000,000 expenditure of public funds.

The western extension of the Pennsylvania Turnpike was opened for traffic in December 1951. Passing to the north of Pittsburgh and about fifteen miles from the Triangle, ready access is provided by means of the Penn-Lincoln Parkway East and State Routes 8 and 19 to the west.

Lower Hill Project

Adjoining the Triangle on the east is a section known as the "Hill District." One of the older parts of the city, a large part of it has many characteristics of a slum area with an extremely wasteful street pattern of land use. After careful study the city planning commission has certified 105 acres immediately adjoining the Triangle as subject to redevelopment. The Urban Redevelopment Authority of the city is now in the process of working out an agreement with the Housing and Home Finance Agency of the Federal Government for federal aid in redeveloping the area.

The plan provides for use of about one-half of the area for a combined public auditorium and sports arena, a symphony and grand opera building, and a building for the Pittsburgh Playhouse. The remainder of the area is planned for modern tower apartments.

To act as redeveloper for the area being set aside for the auditorium, a Public Auditorium Authority has been created. The plan for the auditorium-sports arena is unique. It provides for a retractable roof when the auditorium is in use during the summer by the Civic Light Opera Association. For light opera purposes, 9,000 seats are provided.

During the fall and winter season when the auditorium is used for sports events—basketball, boxing, and ice hockey—by a novel scheme of revolving a portion of the seating arrangement, as many as 16,000 seats can be provided. Conventions may also be held in the auditorium with provision being made for exhibition space. This project has moved to the point that the city and county governments each have agreed to contribute $1,500,000, a local foundation has agreed to contribute $1,000,000, and $2,000,00 is to be raised from corporations and the public. The balance of the funds estimated at $3,000,000 are to be raised by the sale of revenue bonds by the Authority. It is expected that demolition will start in the area during the latter part of 1954. Approximately 3,000 families live in the area. Probably 80 percent of them are eligible for public housing. The Public Housing Authority has recently completed 1,550 housing units, making a total of 7,011 permanent public housing units. These will form the major reservoir to house displaced persons eligible for public housing.

Previously in this article reference has been made to the Crosstown Thoroughfare. Planned to connect with the Penn-Lincoln Parkway, it cuts across the base of the Triangle through the 105-acre redevelopment area. With two free-moving lanes in each direction, it also provides for an additional acceleration or deceleration lane on each side with elaborate connections to the auditorium area. Circular in shape and 400 feet in diameter, the auditorium is completely and immediately surrounded with surface parking areas for about 1,700 car spaces. Additional parking spaces near the auditorium will provide at least 300 more spaces. Two blocks removed from the auditorium is Garage No. 1 of the Public Parking Authority described by Mr. Froehlich in the article titled "Pittsburgh's Parking Authority." There are 786 car spaces in this garage.

The first stage plans for the Crosstown Thoroughfare are in design so that construction may keep abreast of the Lower Hill Project.

Steel Corporation Expands

Another major project accomplished, using the services of the Urban Redevelopment Authority, has been the expansion of the mills of a large steel corporation on the south side of Pittsburgh. As in the case of Gateway Center, the Urban Redevelopment Authority acted as the land assembling agency after the city planning commission had studied and certified the area as being subject to redevelopment under the terms of the Redevelopment Law of the Commonwealth of Pennsylvania. Representing an expenditure of well over $50,000,000, it is unlikely that this expansion would have taken place inside the city had there been no redevelopment authority to acquire the land.

Mass Transportation

The Allegheny Conference has not been unmindful of the important part of mass transportation in moving people. The conference carried on two studies of the mass transit problem in the Pittsburgh area. In Allegheny County there are some fifty-one different operating mass transit companies. Seventeen of these are long-line carriers, seventeen operate outside the city in the county, and seventeen enter the Triangle. As a result of the conference's studies, it recommended unification of all the carriers into one company excluding the long-line carriers. The Board of County Commissioners, subsequent to the conference reports, carried on a study through a committee called the Allegheny County Mass Transportation Study Committee.

This committee filed its report last June and recommended not only unification, but also the creation of a Mass Transit Authority to accomplish the unification. Since it is felt desirable that special legislation be passed to authorize the creation of the Authority, a committee is now at work drafting the legislation to be submitted to the 1955 session of the State Legislature.

The great expansion in the aviation industry had made the old County Municipal Airport obsolete for modern commercial and jet planes. Not only was the field inadequate, but the terminal facilities as well.

Greater Pittsburgh Airport

In May 1952 the County of Allegheny completed and opened one of the finest airport terminal buildings in the country. A new landing field had been constructed during the early years of World War II about fourteen miles west of the city. With runways of adequate length for modern aviation, and protected approach zones, the new field and terminal building should adequately serve the district for many years to come. An access highway from the airfield connects directly with the Penn-Lincoln Parkway West. Over these modern highways the present driving time to the field from the Triangle is twenty-five minutes. When the new tunnels are completed under Mt. Washington this time should be reduced to about twenty minutes.

Recreation

Recreation facilities in the Pittsburgh area have been expanded during recent years. In the city in 1947 the voters approved a bond issue of $4,000,000 for new swimming pools and playgrounds. There have been constructed in Pittsburgh what are called "parklets." Nine of these parklets have been built. Initially started and financed by a private citizen, the city has continued the program with city funds. Parklets are small play areas in congested parts of the city. About one-half to one acre in extent, they are fenced, have slides, swings, sandboxes, and shower pools for little tots. Here the mother can take her children where they may play in safety both from automobiles and the rougher play of older children.

Through the combination of private funds and city funds, a fine children's zoo has been built, as well as a new aviary-conservatory paid for by city funds.

Beyond the city and county limits, yet within reasonable driving distance, the state has built Raccoon Creek Park and Shawnee Park.

The Western Pennsylvania Conservancy, a privately-financed

group interested in conservation and recreation, has also acquired two fine sites. One known as Ferncliff Park at Ohiopyle is south of the city; the other planned to embrace 6,000 acres, is north of the city at historic McConnell's Mill.

Cultural and Educational Facilities

Earlier in this article it was stated that the conference believed a community improvement program must be broad and balanced.

To this end there has been carried on an expansion of educational and cultural facilities. While the conference as an organization cannot claim credit for much of this expansion, yet many of the conference sponsors are on the boards of the institutions of higher learning and other cultural agencies.

The University of Pittsburgh has a building program well under way calling for expenditures of over $19,500,000. The Medical Center is engaged in a large expansion program. Carnegie Institute of Technology, Pennsylvania College for Women, Mt. Mercy College, and Duquesne University are all engaged in large physical expansion programs.

Last fall the Federal Communications Commission granted a construction permit to Educational Television Station WQED. Financed by private grants, this station expects to be on the air by the spring of 1954.

Finance

Where has the money come from? The answer to this question is interesting. It has come from several sources—public funds, private funds, and at times a combination of public and private money. State highway projects such as the Penn-Lincoln Parkway have been financed largely from state highway funds and normal federal aid. The County of Allegheny did contribute $5,000,000, and the City of Pittsburgh gave $1,000,000 toward the cost of the Parkway East. County highway and bridge projects have been financed by the sale of general obligation bonds. Point Park is financed by funds provided by the Commonwealth of Pennsylvania. Gateway Center has been financed by funds from the Equitable Life Assurance Society.

Readjustment of street facilities have been financed by the City of Pittsburgh through the sale of general obligation bonds. The Crosstown Thoroughfare is being financed by a grant of $2,500,000 by the County of Allegheny and $2,750,000 of City bond funds. In the section of this article on the Lower Hill Redevelopment, mention has been made of the financing of the Auditorium. The remainder of the project will be financed by private funds. Federal funds to help cover the writedown cost of the buildings to be razed will also be made available. Industrial and commercial buildings have been financed by private funds. The new Greater Pittsburgh Airport is largely financed by funds provided by Allegheny County with minor assistance from the Civil Aeronautics Authority and the Commonwealth of Pennsylvania. The flood control program has been financed by federal funds. This gives, in general, the pattern of financing the major projects in the program. The conference is financed by private funds provided by business and industry.

Corollary Benefits

It would be safe to say that none of those initially interested in the Allegheny Conference could foresee the broad benefits to the community that have resulted from the program as planned. Who then could foresee the $1,500,000,000 invested in plant expansion and new plants in the four-county area during the last seven years? Who could foresee the towering 41-story Mellon-Steel Building, the fine new Aloca Building, the great expansion in the Triangle of Kaufmann's Department Store; that great national corporations would definitely establish their home offices in Pittsburgh; that great company research centers would be established here? Well, it has been done.

But greatest of all has been the change in attitudes. At all levels of society, Pittsburghers now believe in their town, and top level business leaders have accepted civic responsibility along with their business responsibility. While the millennium has not come to Pittsburgh, it is experiencing a great civic renaissance which can well be a source of inspiration to other cities.

Cycle Length and Signal Delay

THEODORE M. MATSON
AND WILLIAM R. MCGRATH

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Mr. McGrath has been associated with the Yale Bureau of Highway Traffic since February, 1950 as research assistant. From September, 1950 to June, 1951 he was a fellowship student at the Bureau. He is a junior member of the Institute of Traffic Engineers and of the American Society of Civil Engineers. He is a registered Engineer in Training, New York State.

THE purpose of well designed signal installations is the safe passage of the diverse traffic streams approaching the intersection with a minimum amount of delay. While the number and arrangement of phases employed is a very important aspect in holding traffic delay to a minimum it is also known that the amount of delay incurred is dependent on cycle division and length.

In practice, it has been found that cycle length at signalized intersections may be determined with relatively satisfactory results through empirically established relationships. Generally speaking, the division of cycles is determined by allocating time proportionate to the number, type, and turning movements of vehicles found in the critical lanes in each phase, but the duration of cycle length raises questions which demand a more satisfactory basis of approach.

It is of interest, therefore, to consider the underlying principles of signalization and to base computations on derived relationships which take into account as many of the real factors as can be evaluated. Investigation into the basic principles of cycle division and duration properly begins with a study of delay.

Delay

In signal operations, traffic usually moves uninterruptedly into and through the intersections during the "green" and "yellow" intervals.

Thus, when a signal interrupts a flow of traffic a certain number of vehicles will be stopped due to the red signal alone. The number of vehicles stopped will require time to get started and under way again so that an additional number of vehicles may be stopped due to the starting performance of the queue which has been accumulated on the red signal. The number of vehicles which will be stopped or delayed and the duration of their delay is thus dependent on the red interval, the arrival headways in the flow, and the starting performance of the queue.

Let R = Interval of stop signal aspect in seconds.
n = Number of vehicles stopped in R.
i = Any selected one of the n vehicles.
A = Average headway of vehicles on arrival in seconds.
D = Headway of departure at intersection entry.

Note: D is known (from experimental data) to vary for successive vehicles up to $n = 6$ and then remain relatively constant for $n > 6$.

d_i = Delay in seconds for vehicle i.
T = Total delay in seconds for all vehicles.

On the average, the first vehicle will be stopped at the point of interruption for the duration of $R - \frac{A}{2}$. The second vehicle will arrive A seconds later and will be delayed accordingly $(R - \frac{A}{2}) - A$ or $R - \frac{3A}{2}$ seconds. The third vehicle will arrive an additional headway later and will thus be delayed $(R - \frac{3A}{2}) - A$ or $R - \frac{5A}{2}$. Therefore, the "ith" vehicle will be delayed by the red light $R - \frac{A(2i-1)}{2}$ seconds.

But after the red light is changed to green there is an additional delay for each vehicle. This additional delay is dependent on the starting performance of the entire queue of vehicles which have been stopped by the red light including the given vehicle. Since D is a variable this additional delay for a given vehicle amounts to $\sum_{x=1}^{i} D_x$ so that the delay to any vehicle becomes;

$$d_i = R - \frac{A(2i-1)}{2} + \sum_{x=1}^{i} D_x$$

Note: D_x is departure headway of the x^{th} vehicle. The sum of the individual delays then becomes the total delay for n vehicles.

$$T = nR - \frac{n^2 A}{2} + \sum_{x=1}^{n} \sum_{x=1}^{i} D_x$$

Note: The sum, $\sum_{i=1}^{n} \frac{A(2i-1)}{2}$, is the sum of $(1 + 3 + 5 + 7 \ldots\ldots + n)\frac{A}{2}$ which is $\frac{n^2 A}{2}$.

Now if D is assumed to be a constant:

$$T = nR - \frac{n^2 A}{2} + \frac{n(n+1)D}{2}$$

Note: The expression, $\frac{n(n+1)}{2}$, is the sum of $(1 + 2 + 3 + 4 \ldots\ldots + n)$ which is the coefficient of D.

But D in the expression above is a variable. Empirical values for median values of D found in practice for "straight through" passenger automobiles are as follows:

When x =	D_x =	$\sum_{x=1}^{i} D_x$ =	or	$\sum_{x=1}^{i} D_x$ =
1	3.8 = 2.1 + 1.7	2.1 + 1.7	=	2.1 + 3.7 − 2.0
2	3.1 = 2.1 + 1.0	4.2 + 2.7	=	2.1i + 3.7 − 1.0
3	2.7 = 2.1 + 0.6	6.3 + 3.3	=	2.1i + 3.7 − 0.4
4	2.4 = 2.1 + 0.3	8.4 + 3.6	=	2.1i + 3.7 − 0.1
5	2.2 = 2.1 + 0.1	10.5 + 3.7	=	2.1i + 3.7 − 0.0
6	2.1 = 2.1 + 0.0	12.6 + 3.7	=	2.1i + 3.7 − 0.0
7	2.1 = 2.1 + 0.0	14.7 + 3.7	=	2.1i + 3.7 − 0.0
n	2.1 = 2.1 + 0.0	2.1n + 3.7	=	2.1n + 3.7 − 0.0

Accordingly for passenger car queues:

$$\sum_{x=1}^{n} \sum_{x=1}^{i} D_x = \frac{2.1n(n+1)}{2} + 3.7n - Q$$

in which Q is always 3.5 for $n \geqslant 4$, and when

n =	Q =
1	2.0
2	3.0
3	3.4
4	3.5

(Note: These empirical values will vary due to composition of flow, turning vehicles, pedestrian interference, and other factors.)

The total delay becomes:

$$T = nR - \frac{n^2 A}{2} + \frac{2.1n\,(n+1)}{2} + 3.7n - Q$$

An example of the delay caused by a signal interruption is set forth graphically in Figure 1 wherein the following conditions are assumed:

R = 40 seconds
A = 10 seconds or 360 passenger vehicles per hour.
D = Passenger car performance—empirical. With no undue delay caused by left turns, pedestrians, heavy vehicles, etc.

It will be seen from Figure 1 that four vehicles were stopped by the red light alone. Two additional vehicles were stopped by the queue formation and its clearance. Thus, six vehicles were delayed for a maximum of 38.8 seconds for the first vehicle to a minimum of 1.3 seconds for the last vehicle. The seventh vehicle though not forced to stop, would have its headway reduced below 10 seconds.

It will be further noted from Figure 1 that the total delay, T, increases to a maximum of approximately 123 seconds when the sixth vehicle entered the intersection.

In any case, there is a unique number of vehicles, n, which will be delayed and this number occurs when total delay, T, is at its maximum. The point of maximum delay may be found by taking the first derivative of T with respect to n and equating to zero as follows:

$$T = nR - \frac{n^2 A}{2} + \frac{2.1n\,(n+1)}{2} + 3.7n - Q$$

$$\frac{dT}{dn} = R - nA + 2.1n + 1.05 + 3.7 = 0$$

Hence: $n = \frac{R + 4.75}{A - 2.1}$

In the above example shown in Figure 1

$$n = \frac{40 + 4.75}{10 - 2.1} = 5.6 \text{ or } 6 \text{ vehicles.}$$

Thus the number of vehicles, n, which will be delayed varies directly with the sum of the duration of the red signal plus a constant

composed of the time losses in starting the queue of accumulated vehicles and inversely as the difference between arrival headway and departure headway.

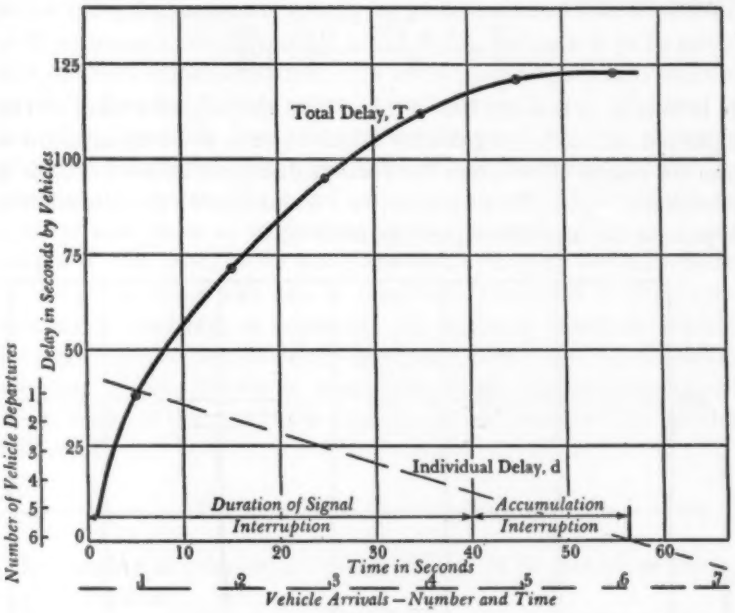


FIGURE 1

As R increases, the number of delayed vehicles increases, and as the sluggishness of departure increases, delay increases as evidenced by the appearance of the factor of sluggishness in the numerator and departure headway in the denominator. The influence of volume is also apparent remembering that A decreases with increased volume. While the influences of R and A are not as readily apparent in the equation for delay, the effect of sluggishness on departure is evident.

The length of queues which will form for an average interruption of R = 30 is shown in Figure 2; while these queue lengths become very large (over 15) at 800 v.p.h., they are excessive (over 40) at 1200 v.p.h.

If the derived value for the number of vehicles delayed per signal interruption is inserted in the equation for delay and it is then divided by the number of delayed vehicles, the average delay per vehicle becomes:

$$\frac{T}{n} = \frac{R + 4.75}{2} - \frac{Q\,(A - 2.1)}{R + 4.75}$$

It is only at extremely low volumes that the negative term of this equation becomes of significant relative size as to be meaningful so that for nearly all volumes the average delay per delayed vehicle is practically $\frac{R + 4.75}{2}$. This assumes that every delayed vehicle is allowed to pass on the next subsequent go interval.

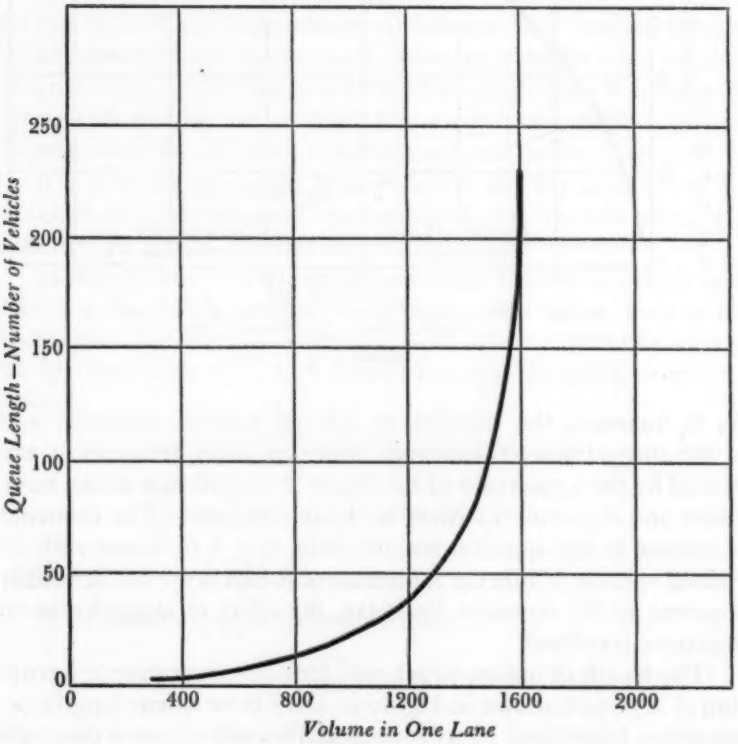


FIGURE 2

Cycle Length

A primary objective in the signalized operation of an intersection is to achieve the required capacity for each flow but with a minimum of delay to each flow. From the previous discussion it is to be noted that the least delay is incurred by a given flow when R is as short as possible. But the R for a given phase is dependent on the sum of the "Go" intervals (including clearance intervals) for all other phases. At the same time, the length of the "Go" interval for any phase must be such that it will accommodate all vehicles which arrive for that phase of movement during the cycle. The minimum length of "Go" interval for any phase should be such that all vehicles in the given phase will pass at minimum headways of departure; minimum headways of departure are achieved when all vehicles for a given phase have been brought into a queue of stopped vehicles awaiting release. Moreover, when each vehicle departs with a minimum headway the maximum capacity of the signalized intersection will result.

Theoretical Cycle Computations

The number of vehicles, n′, which will arrive for any phase during a given cycle is:

$$n' = \frac{C}{A} \text{ where } C = \text{cycle length in seconds}$$

It will be recalled, however, that the number of vehicles which accumulate for a given interruption is $n = \frac{R + K}{A - D_k}$

(Note: $K = 4.75$ for typical passenger car performance in previous example and D_k is the constant value of D, here $= 2.1$)

The duration of R which will stop all arriving vehicles, therefore, becomes: $R = n\,(A - D_k) - K$.

But for any given phase n should equal n′, under which condition the required capacity will be achieved with the shortest possible R. For any phase then:

$$R = \frac{C}{A}(A - D_k) - K$$

The total length of a cycle must be such as to accommodate the R's of all phases. The cycle length also will be equal in duration to the sum of all G's or:

$$C = G_1 + G_2 + G_3 + \ldots . \text{ etc.}$$

Hence,

$$C = \sum_{x=1}^{\phi} G_x$$

Wherein $\emptyset$ = number of phases
But for any phase, $G = C - R$

Hence,

$$C = (C - R_1) + (C - R_2) + (C - R_3) + \ldots .$$

$$= \phi C - (R_1 + R_2 + R_3 + \ldots .)$$

$$C(\phi - 1) = R_1 + R_2 + R_3 + \ldots .$$

$$C = \frac{R_1 + R_2 + R_3 + \ldots}{\phi - 1}$$

Hence, a cycle length is the sum of the individual *red intervals* in seconds divided by the number of phases less one; which is also the sum of all green intervals.

Substituting for R

$$C = \left[\frac{C}{A_1}(A_1 - D_{k1}) - K_1\right] + \left[\frac{C}{A_2}(A_2 - D_{k2}) - K_2\right] + \ldots .$$

$$= \frac{\sum_{x=1}^{\phi} K_x}{\left[\sum_{x=1}^{\phi} \frac{A_x - D_{kx}}{A_x}\right] - (\phi - 1)}$$

For two phase operation this simplifies to:

$$C = \frac{K_1 + K_2}{\left[\frac{A_1 - D_{k1}}{A_1} + \frac{A_2 - D_{k2}}{A_2}\right] - 1}$$

If idealized pure passenger auto performance is assumed for each phase, D_k becomes 2.1 and K becomes 4.75.

Hence:

$$C = \frac{9.5}{\frac{A_1 - 2.1}{A_1} + \frac{A_2 - 2.1}{A_2} - 1}$$

But since A (seconds per vehicle) is the reciprocal of volume in *vehicles per second,* then, $A = \frac{3600}{V}$ where V is volume expressed in vehicles per hour. In general, then,

$$C = \frac{3600 \sum_{x=1}^{\phi} K_x}{3600 - \sum_{x=1}^{\phi} V_x D_{kx}}$$

and for idealized passenger auto performance in two phase operation

$$C = \frac{34{,}200}{3600 - (V_1 + V_2)\,2.1}$$

Thus, it is seen that when the sum of vehicles per hour in both phases of operation produces volumes approaching $\frac{3600}{D_k}$ (or one vehicle each 2.1 seconds) over the collision point, capacity of the intersection will have been achieved and the cycle length becomes infinitely large. Whereas, the minimum cycle length is reached when volumes are zero and C approaches the time loss due to sluggishness in starting. Moreover, a given volume on one phase establishes the limit of volume in the other phase.

The cycle lengths indicated for various total volumes are shown in Figure 3. It is seen that when maximum limits of practical cycle lengths (about 100 seconds) are reached, on this theoretical basis, maximum volumes of about 1500 passenger automobiles per hour are developed over a given conflict point. This value may be approached in practice.

It will be seen from the above calculations of cycle length that there are four factors of concern. They are:

1. The sluggishness factor in starting a queue of stopped vehicles.
2. The headways of arrival, or volume.
3. The headways of departure.
4. The number of phases.

Also;

As sluggishness is increased due to left turns, heavy vehicles, pedestrian interference, etc., the required cycle length increases;

As headways of arrival decrease, the required cycle length increases;

As headways of departure increase, required cycle length increases;

As the number of phases increase, the required cycle length increases; and in any event, a given cycle length has its equivalent capacity which cannot be exceeded.

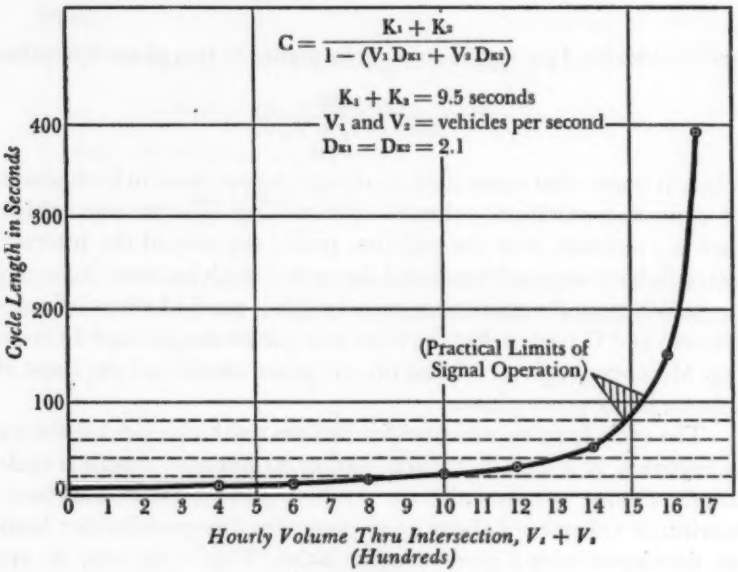

$C = \frac{K_1 + K_2}{1 - (V_1 D_{K1} + V_2 D_{K2})}$
$K_1 + K_2 = 9.5$ seconds
V_1 and V_2 = vehicles per second
$D_{K1} = D_{K2} = 2.1$
(Practical Limits of Signal Operation)
Cycle Length in Seconds
0
100
200
300
400
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Hourly Volume Thru Intersection, $V_1 + V_2$ (Hundreds)

FIGURE 3

Theoretical Cycle Length (Random Arrival Headways)

If traffic moved with exactly uniform gaps or headways the foregoing computation of cycle lengths would be accurate. It has been found however that traffic streams tend toward a random arrangement of vehicles such that in any interval of time the number of vehicles arriving at a given point can vary considerably from the

average number found in the uniform arrival method developed above. The extent of this variation and the probability of its occurrence can be estimated by use of the Poisson distribution function wherein:

$$P_{(x)} = \frac{e^{-a}\, a^{x}}{x!}$$

Thus a cycle composed of intervals constructed so as to accommodate only the average number of vehicles may be (1) too long when fewer vehicles arrive or (2) too short when a greater than average number of vehicles arrive. In the former case, green time may be lost and resultant capacity is thereby impaired; in the latter case, vehicles will accumulate and thereby incur additional delay. In order to achieve the required capacity and at the same time avoid needless accumulations with incident delay, the cycle must necessarily be increased.

The average number of vehicles, "a," which will arrive in a given cycle length, C, is dependent on Volume, *V*. The maximum number of vehicles, x, which might arrive in a given cycle length, C, is not only dependent on "a" but also on the detailed longitudinal arrangement of the vehicles in the flow. Since this vehicle arrangement can generally be assumed to follow Poisson's law of distribution, the probability, P, of any number x or less arriving on any cycle may be computed. This probability, P, may be interpreted as the percentage of all cycles in which x or less vehicles will actually arrive. If x is the capacity of a particular cycle length, the remaining percentage of cycles will receive more than their capacity which will result in failure and create accumulation.

It is obvious that for any reasonable cycle length some failures must be expected. The number that are tolerable may be selected as a criterion for cycle length. Accordingly, it becomes necessary to adopt some value of P which will be found satisfactory in practice. It can be shown that if the length of a cycle is such that a given "go" interval within it has just enough capacity to pass the average number of vehicles, "a," which arrive in cycle C, the cycle may fail to yield adequate capacity up to half the total time. This condition will of course lead to excessive accumulation of vehicles waiting for the "go" interval and delay will be needlessly high.

It can be further shown that for slight increase in cycle length,

relatively high increases in the probability that each interval will be able to discharge the actual number of vehicles which will arrive during the cycle are achieved. The question thus asserts itself as to the probability value to be employed which will actually incur the minimum delay. Practice indicates that when P values are established so that about 95 cycles out of each hundred will not fail to discharge as many vehicles as arrive, satisfactory performance is achieved.

The determination of cycle length, assuming random arrival headways, so as to establish a satisfactorily high level of probability that each interval will pass as many vehicles as arrive during the cycle can best be illustrated by a practical example:

Problem

At a given intersection, which is to be placed in two phase operation, the critical lane of approach in phase (1) carries 600 vehicles per hour and in phase (2) 200 vehicles per hour during peak periods. A cycle length in which each "go" interval will accommodate as many vehicles as arrive in the cycle about 95 per cent of the time is desired.

Solution

If uniform spacings in each flow were assumed the theoretical cycle length would be computed as follows:

$$C = \frac{4.75 + 4.75}{1 - (\frac{600 + 200}{3600})\,2.1} = 17.8 \text{ seconds}$$

In each cycle then phase (1) must handle "a_1" vehicles, or $\frac{600 \times 17.8}{3600}$ or 2.97 vehicles per cycle and phase (2) will handle "a_2" vehicles or $\frac{200 \times 17.8}{3600}$ or 0.99 vehicles per cycle.

If 4.75 seconds is allowed as the K factor to get each flow under way, and headways of departure are assumed 2.1 seconds,

phase (1) will be (2.97 x 2.1) + 4.75 or 10.95 seconds
phase (2) will be (0.99 x 2.1) + 4.75 or 6.85 seconds.

It is seen that the capacity of each of these "go" intervals is exactly equal to the average number of vehicles which arrive, that is (in

whole numbers) phase (1) will accommodate 3 vehicles and phase (2) will handle 1 vehicle per cycle. The probability that these intervals will accommodate the actual number of vehicles which might arrive if random spacings are assumed may be computed by summing the probabilities of x vehicles arriving from $x = 0$ to $x =$ capacity of the respective interval.* When this is done

P for phase (1) is 0.64 or 36 per cent failure.
P for phase (2) is 0.74 or 26 per cent failure.

Such cycle is obviously too short, and this percentage of failures will create staggering accumulations of vehicles.

By increasing the intervals' lengths, to the point where their capacities are at least as great as the maximum *number of vehicles* which might arrive during 95 percent of the cycles, more practical cycle lengths will be found. This has been done for the present problems in the following table of values.

From the table it is seen that it has been necessary to extend the theoretical cycle length from only 18 seconds to 45 seconds to obtain the desired level of satisfactory performance. For the idealized conditions, pure passenger car operation with no interferences from turns or pedestrians and no losses of time due to inattention or erratic behavior, this becomes the proper cycle length for the indicated volumes. Similar computations for other values lead to the results presented in Figure 4. For two phase operation the correct theoretical cycle length for any pair of volumes may be found from this figure.

Table 1

CYCLE COMPUTATION
(Illustrative Example)

	Phase (1)					Phase (2)				
Values of C In Seconds	Go Sec.	Stop Sec.	Cap. Vehs.	Av. Ar. Vehs.	Values of P	Go Sec.	Stop Sec.	Cap. Vehs.	Av. Ar. Vehs.	Values of P
18.0	11.1	6.9	3	2.97	.64	6.9	11.1	1	.99	.74
22.2	13.2	9.0	4	3.7	.69	9.0	13.2	2	1.2	.88
26.4	15.3	11.1	5	4.4	.72	11.1	15.3	3	1.5	.94
28.5	17.4	11.1	6	4.8	.80	11.1	17.4	3	1.6	.92
32.7	19.5	13.2	7	5.5	.81	13.2	19.5	4	1.8	.96
34.8	21.6	13.2	8	5.8	.87	13.2	21.6	4	1.9	.95
36.9	23.7	13.2	9	6.2	.90	13.2	23.7	4	2.0	.95
39.0	25.8	13.2	10	6.5	.93	13.2	25.8	4	2.2	.93
43.2	27.9	15.3	11	7.2	.94	15.3	27.9	5	2.4	.96
45.3	30.0	15.3	12	7.6	.95	15.3	30.0	5	2.5	.96

* Such computations are tedious and lengthy. These summations may be found in Molin, E. D., *Poisson's Exponential Binomial Limit*, D. Van Nostrand and Co., 1945.

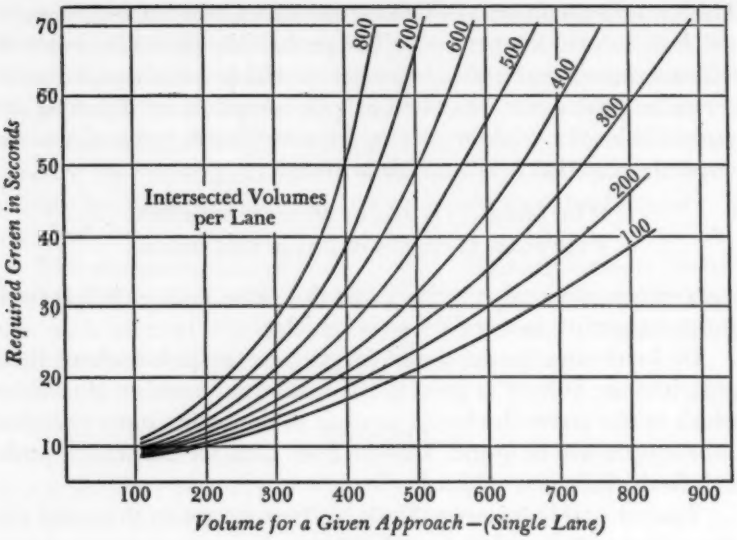


FIGURE 4

Practical Cycle Length

All previous computations have been based on passenger car operations with no time losses other than those inherent to the requirement for setting a queue in motion. Studies have shown that these losses which average nearly 5 seconds for every phase adequately account for inertia of starting and chance variations in individual performance. There are two phenomena occurring at nearly every intersection, however, which must be given special consideration, namely, left turns and the presence of trucks and other large or sluggish vehicles in the traffic flows.

Studies have shown that due to delay enforced by opposing traffic left turns generally require an average of approximately 1.3 additional seconds to clear the intersection. In view of the fact that this additional required time is imposed upon the entire stream, it becomes the equivalent of an additional partial vehicle in the flow requiring only 1.3 seconds to pass instead of the basic 2.1 seconds. Thus a left turning vehicle may be thought of as the equivalent of $\frac{2.1 + 1.3}{2.1} = 1.6$ straight through vehicles.

In computing cycle lengths then, a flow of say 400 vehicles per hour with 10 per cent left turns may be thought of as an equivalent volume of

$$(400 \times 0.90) + (400 \times 0.10 \times 1.6) = 424 \text{ vehicles per hour.}$$

Sluggish or large vehicles have been found to impose a similar effect on the traffic flow. It has been found that each truck or bus consumes approximately 1.5 times the amount of departure time required for a passenger vehicle. Thus each of these vehicles is the equivalent of

$$\frac{1.5 \times 2.1}{2.1} = 1.5 \text{ passenger vehicles}$$

For a flow of 400 vehicles per hour, of which 10 per cent is trucks, the equivalent value becomes

$$(400 \times 0.90) + (400 \times 0.10 \times 1.5) = 420 \text{ vehicles per hour.}$$

These equivalent volumes then may be used directly in connection with Figure 4 to estimate a required cycle length adapted to more realistic conditions.

Suppose that in the previously discussed example of 600 vehicles per hour intersecting 200 vehicles per hour there were 15 per cent left turns and 10 per cent trucks in each flow. The equivalent volumes are:

$$(600 \times 0.75) + (600 \times 0.10 \times 1.5) + (600 \times 0.15 \times 1.6) = 684 \text{ v.p.h.}$$
$$(200 \times 0.75) + (200 \times 0.10 \times 1.5) + (200 \times 0.15 \times 1.6) = 228 \text{ v.p.h.}$$

With these two latter equivalent volumes, Figure 4 may be entered and it is found that thirty-eight seconds of go interval are required for the major phase and seventeen seconds for the minor phase. The total cycle length is fifty-five seconds. This becomes the practical cycle length to be employed under the conditions stated. If such cycle length were used it is expected that not more than five times out of 100 would more vehicles arrive on either approach during one cycle than that cycle could discharge. Analysis shows that nominal lengthening of the cycle would not greatly reduce this failure ratio whereas only slight shortening would greatly increase it with resultant large accumulations and additional delays.

Cycle Length Limitations

All foregoing computations assume that it would be feasible to install any cycle length found to be desirable under the stated criteria. There are, however, practical considerations which are generally accepted as limiting maximum and minimum cycle lengths which may be employed.

The needs of pedestrians have a profound effect upon minimum cycle lengths. Studies have shown that the average pedestrian walking properly in the crosswalk and with the "go" interval walks approximately three to four feet per second. In addition pedestrians exhibit a starting time requirement of three to four seconds after receiving the "go" indication. It is axiomatic that at least those pedestrians who are waiting at the curb must be allowed time to comfortably cross the roadway. Thus, roadway width and pedestrian speed become the limiting factor in minimum interval length. For ordinary road width of thirty to forty feet the interval must be thirteen to twenty seconds in length. This minimum length should be computed individually for every signal timing problem. In general it has been found that rarely is an interval of less than fifteen seconds permissible, resulting in a minimum practical cycle length of thirty seconds.

Whenever any green interval is established on pedestrian clearance time, rather than a vehicle accommodation basis, it becomes necessary to make compensating increases of green interval(s) in the complementary phase(s) of a given cycle. In the use of Figure 4 entry is made from the ordinate values of green time and equivalent volumes will be read on the abscissa scale. For example, at the intersection of 200 vehicles per hour with a stream of 500 vehicles per hour thirteen seconds are indicated for the lesser stream. If fifteen seconds are required for sake of pedestrian accommodations the equivalent vehicle flow will be 250 instead of 200 and the larger stream will require twenty-six seconds instead of twenty-four.

Maximum cycle lengths do not have as well defined limits as do minimum lengths. Examination of Figure 4 shows that total volumes in excess of 1100 to 1200 vehicles per hour require cycle lengths which increase greatly for only small increases in volume. Even at

a total of 1200 vehicles per hour cycle lengths are from about 135 to 160 seconds depending upon the proportion in each flow. It is recognized that with long cycles such as these, psychological factors of annoyance and impatience on the part of drivers waiting for the "go" interval play an increasingly important part in their attitude toward signal performance. For these reasons good practice indicates adoption of an upper limit of about 120 seconds for cycle length. This admittedly increases the failure ratio of the cycles but at these levels that seems less serious than imposing longer waits for any vehicle. It should be understood however that cycles set at this length where much longer lengths are indicated cannot be expected to give as good performance as could be desired. This condition indicates that the intersection is being forced to handle volumes in excess of its signalized capacity and that improvements beyond mere signalization are required.

Multiple Phase

All foregoing computations may be applied to finding cycle lengths for situations in which more than two phases are to be employed. The method outlined in Table 1 may be extended to any desired number of phases. The data of Figure 4 unfortunately are not applicable although they may be used for a first try to obtain a reasonable cycle length on which to base the more tedious computations shown in Table 1.

An example is shown below:

	Volume
Phase A	200
B	300
C	400

	Consider	*Required Green*
In Figure 4	200 vs. 700	16
	300 vs. 600	24
	400 vs. 500	27
		67

	Phase A				Phase B				Phase C			
Cycle	Go	Cap.	Avg.	Prob.	Go	Cap.	Avg.	Prob.	Go	Cap.	Avg.	Prob.
68.05	17.35	6	3.8	.91	23.65	9	5.7	.93	27.05	11	7.7	.91
74.35	19.45	7	4.1	.94	25.75	10	6.6	.95	29.15	12	8.3	.92
80.65	21.55	8	4.5	.96	27.85	11	6.7	.96	31.25	14	9.0	.96

It is seen that the required cycle found by considering each of the flows as opposed by the total flow of the other two phases is not long enough to satisfy the probability requirements. Furthermore the difference cannot be accounted for solely by consideration of the additional 5 seconds lost time imposed by the third phase. A basic probability phenomena is thus exposed. It is seen that a given volume requires more time when split into more than one flow than it does when kept as a single flow, due solely to the effects on the probabilities of arrivals. This is a strong argument in favor of using as few phases as possible for any given set of conditions.

Seattle's Crosstown Parkway

JAMES D. BRAMAN

Mr. Braman is chief of the Current Plans Section of the City Planning Commission staff in Seattle, Washington. He holds a degree in Regional Planning from the University of Washington and previously did planning work in Alaska for a private engineering firm. He was responsible for the preliminary design of the crosstown parkway in Seattle.

THE HIGH cost of the rights-of-way often delays the building of vitally needed limited access traffic ways. Freeways require wide rights-of-way, usually through highly developed urban areas. The condemnations are unpleasant for property owners and expensive for taxpayers.

Costs of the projected north-south state freeway through Seattle, vital for both local and regional traffic, are so great that an urban toll highway is being considered and it is getting the rights-of-way through developed areas that account for much of the anticipated cost.

Consequently, when planners and engineers proposed a parkway-arterial through the heavily populated north end of Seattle—admirably located to meet the increasing traffic demands, yet routed through largely undeveloped land—city officials quickly endorsed the project. And these added advantages heightened the enthusiasm:

1. The scenic route, suitable for parkway development, linked a public beach on Lake Washington with a major park on Puget Sound. Intermediate wooded areas were susceptible to park development.

2. Grades along the route were easy. Other crosstown streets in Seattle climbed steep hills.

3. The route followed a natural watercourse for major storm and sanitary trunk sewers to serve large areas.

4. It naturally passed under all principal north-south arterials but one, facilitating limited access treatment with grade separations at principal intersections.

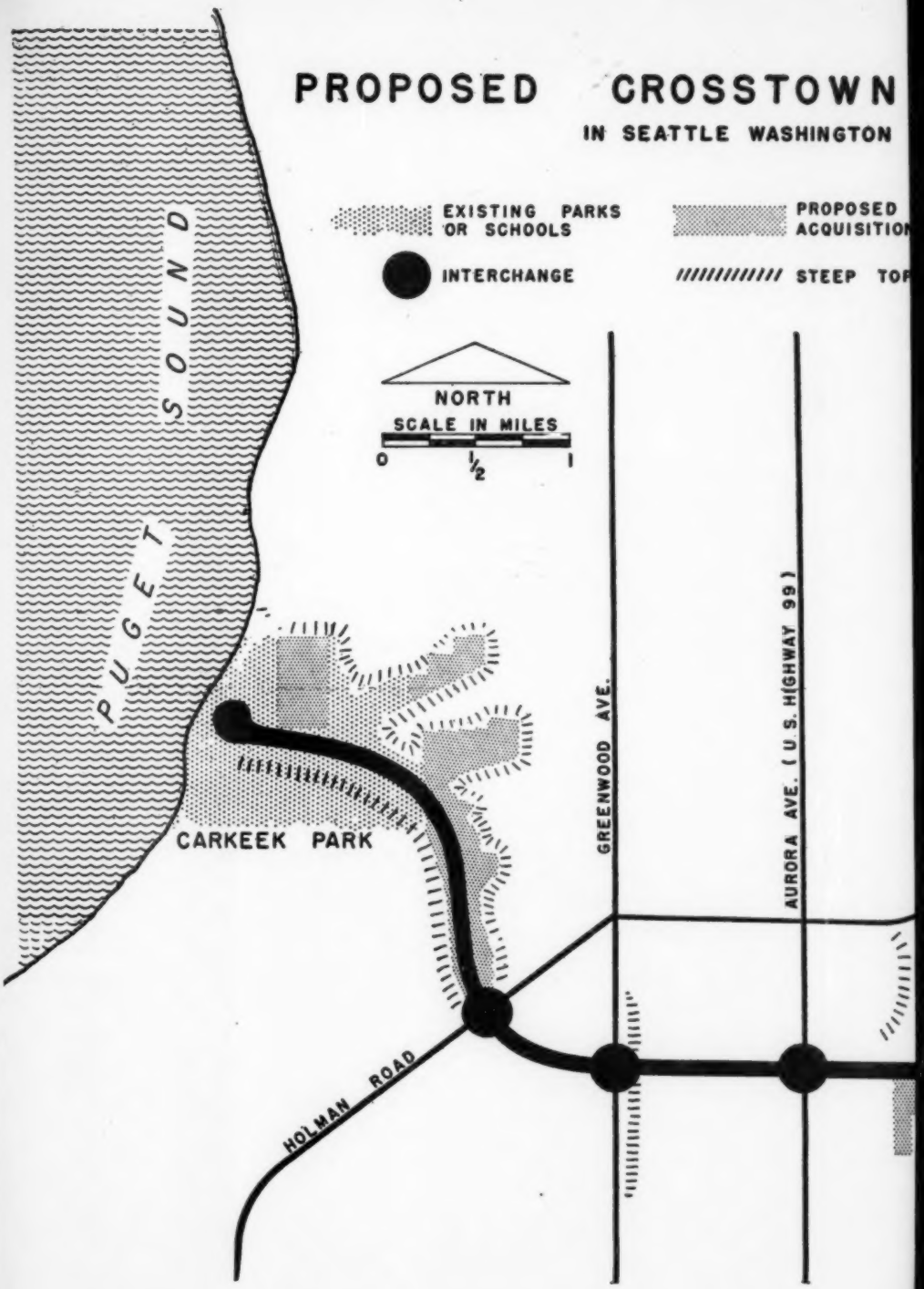
5. The parkway forms a greenbelt through areas becoming solidly built-up and falls on the periphery of natural residential communities.

History of Crosstown Parkway

Although the present plans for Seattle's crosstown parkway were developed in recent years, early planners visualized portions of it. The Olmstead plan for development of parks and parkways in the Seattle metropolitan area, completed in 1903, proposed part of this parkway commencing near present-day Matthews Beach on Lake Washington. The Plan of Seattle, prepared by Virgil G. Bogue in 1911, included two miles of highway that would closely follow the parkway presently proposed. The city never adopted the Bogue plan, but many of Mr. Bogue's thoroughfare proposals have been carried out. No concrete plans for a major arterial in this portion of the North End were forwarded, although a few farsighted persons were undoubtedly thinking of the desirability of one.

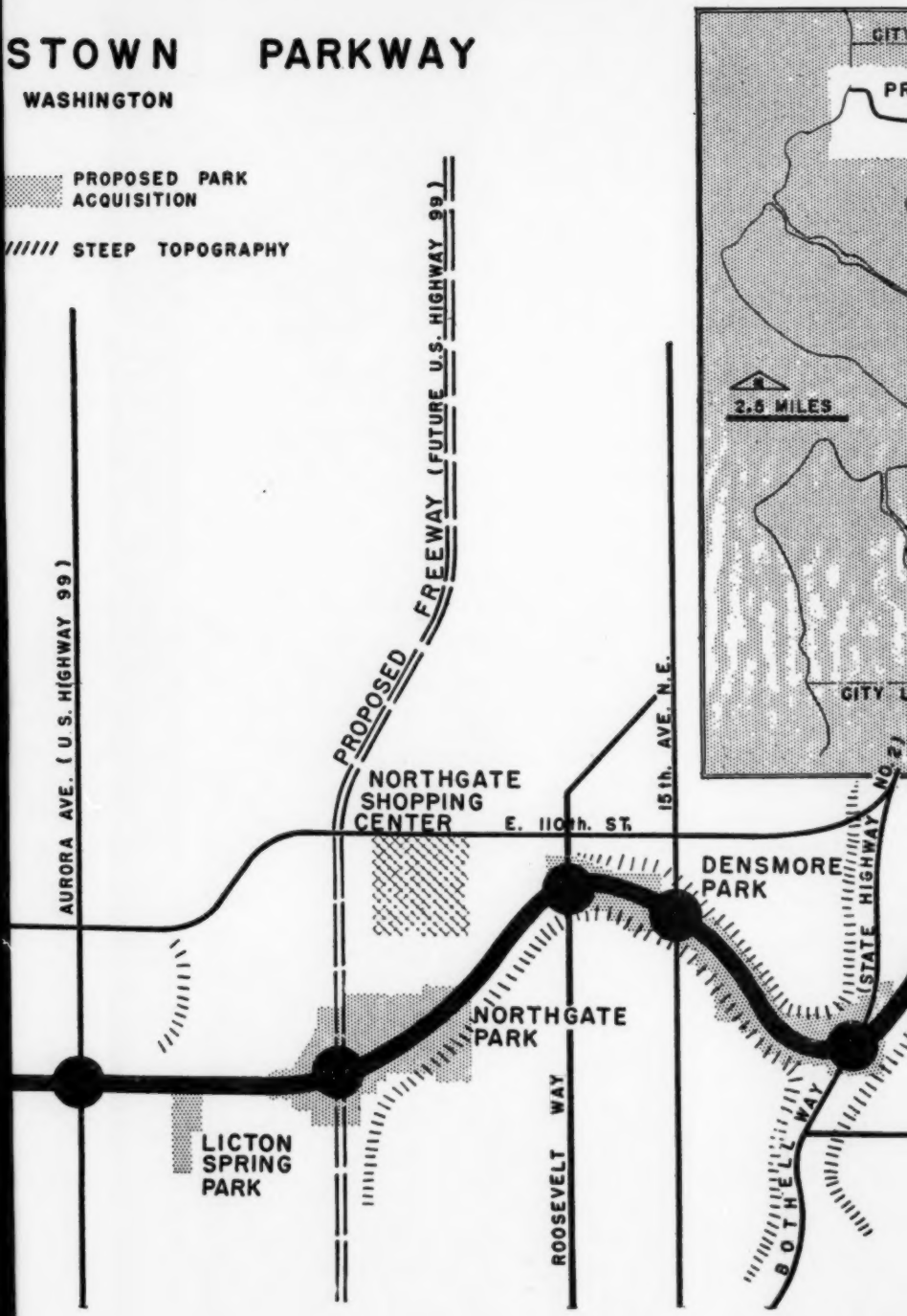
The need for a good crosstown arterial in this area became much more apparent with the completion of the Northgate Shopping Center late in 1950. This enormous center, with parking space for 4,000 cars, created a severe traffic problem immediately after its opening date. The approach-streets on two sides were widened and four traffic signals installed to alleviate the initial congestion. Yet these measures cannot hope to permanently accommodate the traffic generated by the increasing population in the trade area and the expanding number of stores and parking spaces in the center.

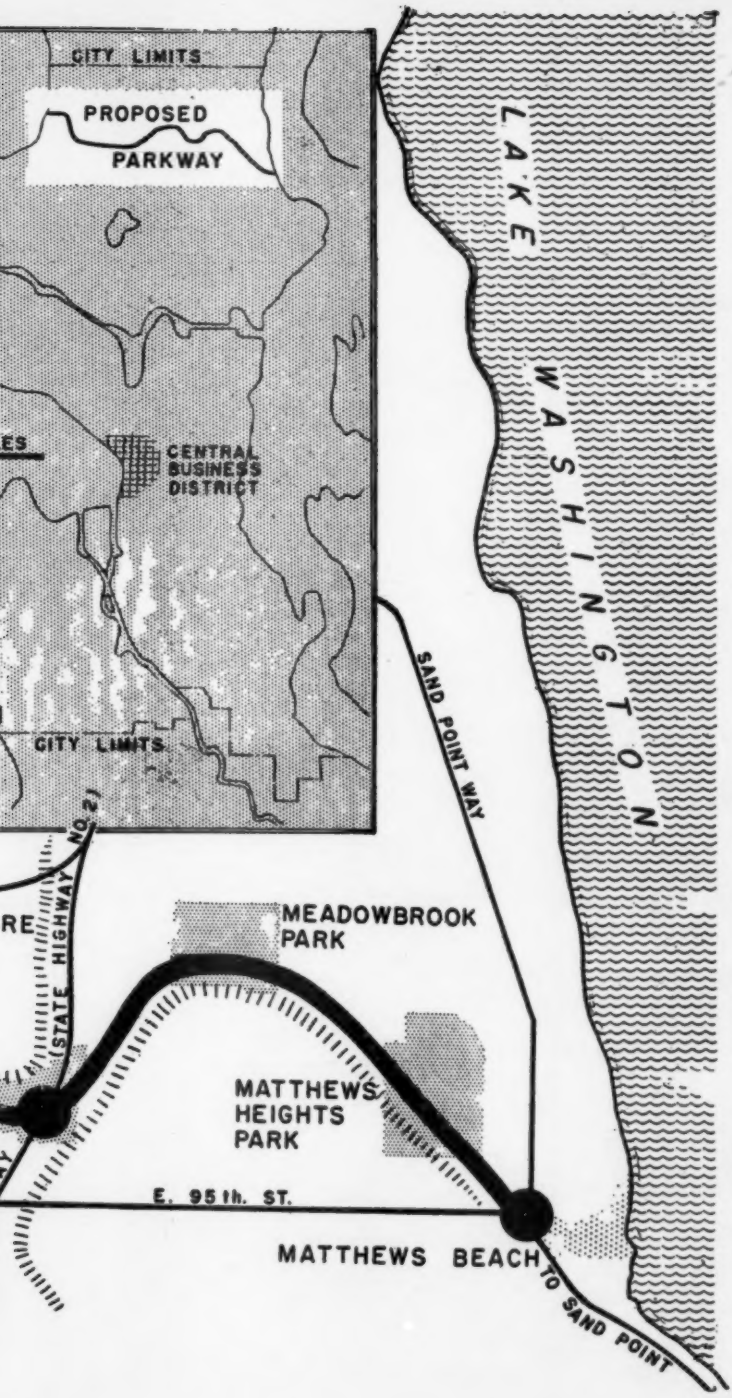
The Washington State Department of Highways, whose major north-south freeway through Seattle will pass immediately to the west of Northgate, and the King County Planning Commission concerned with other arterials in the vicinity, recognized before the opening of Northgate that the traffic it would generate must be an important consideration in any long-range thoroughfare planning for the North End. The idea of using Thornton Creek valley, just south of Northgate, to locate a Northgate access road was conceived. In this valley, relatively vacant land existed between the proposed freeway and State Highway No. 2 (Bothell Way) a distance of one and one-half miles. A traffic route through this valley to connect the


PROPOSED CROSSTOWN
IN SEATTLE WASHINGTON
EXISTING PARKS OR SCHOOLS
PROPOSED ACQUISITION
INTERCHANGE
STEEP TOP
NORTH
SCALE IN MILES
0
1/2
1
PUGET SOUND
CARKEEK PARK
GREENWOOD AVE.
AURORA AVE. (U.S. HIGHWAY 99)
HOLMAN ROAD

STOWN PARKWAY

WASHINGTON




CITY LIMITS
PROPOSED
PARKWAY
CENTRAL
BUSINESS
DISTRICT
CITY LIMITS
LAKE WASHINGTON
SAND POINT WAY
MEADOWBROOK
PARK
MATTHEWS
HEIGHTS
PARK
E. 95th. ST.
MATTHEWS BEACH
TO SAND POINT

two state routes and to provide access from each to Northgate was a highly desirable long-range project.

Early Planning of the Parkway

Staffs of the King County and City of Seattle planning commissions reviewed the inherent possibilities of the suggested traffic route through the valley of Thornton Creek. Both county and city planners were concerned with the proposal, since Thornton Creek lay in the county but in an area slated for early annexation to Seattle. A member of the city planning commission, a licensed pilot, flew over the entire area from Lake Washington to Puget Sound, while another planner took low-level oblique aeriai photographs. A study of these photographs, plus topography and land use maps, supplemented by brief field surveys, indicated that the suggested Thornton Creek route could be extended both east and west, creating a crosstown highway. Furthermore, initial studies immediately showed the possibilities for limited access parkway treatment. Much of the route lay in the valley of Thornton Creek. North-south arterials crossed this valley either on fills or bridges, making grade separations not only simple but virtually unavoidable. The ravine between Bothell Way and Northgate was mostly vacant and luxuriantly wooded with both deciduous and evergreen trees.

Several large vacant tracts, including wooded hillsides and a nine-hole golf course, lie beside the stream the parkway would follow. The wooded ravine and vacant tracts, developed as public parks, would make this traffic route a beautiful urban parkway. The parkway's natural termini—Matthews Beach on Lake Washington and Carkeek Park on Puget Sound—were already city-owned property.

Thus, a crosstown parkway was incorporated into the early comprehensive plans of both city and county planning commissions. Incidental note was made of the parkway in two city planning commission reports to the city council during 1951 and 1952, but no more detailed planning work was done on the parkway until mid-1952. Community clubs in the North End of Seattle learned of the project and endorsed it as highly desirable.

The Study Is Endorsed

In the spring of 1952, a community group petitioned the city to develop a playfield on the vacant tract south of Northgate. Since this land appeared to be on the logical route of the parkway, no positive recommendation on the community group's proposal could be made until a more detailed study of the whole parkway proposal was undertaken. This, plus the fact that vacant land along the probable parkway route was being developed with homes, spurred the city planning commission into further study of the Matthews Beach-Carkeek Park crosstown parkway.

Armed with the aerial photographs taken earlier and with the best topographic maps available, a staff member sketched a probable highway centerline and possible park acquisitions. This preliminary work was confined to the section from Aurora Avenue east to Lake Washington where the natural watercourse of Thornton Creek and large amounts of vacant land made selection of the best route over most of the distance comparatively simple.

Upon completion of this rough sketch plan the city engineer and the superintendent of parks, both of whom are ex-officio members of Seattle's Planning Commission, were briefed on the proposal and invited on a view trip to appraise its possibilities.

On a fine September afternoon in 1952, Seattle's city engineer, superintendent of parks, and director of planning, accompanied by assistants, embarked on a three-mile trip from Northgate to Lake Washington. Most of the journey was made on foot through the valley of Thornton Creek. Dense woods and undergrowth made the going difficult at times, but the trip convinced those present that the parkway would immensely benefit the city as a traffic route and, with adjacent park lands, as a recreational facility. In addition, Thornton Creek valley was obviously the only location for future sanitary and storm trunk sewers serving a wide area, and a right-of-way for such sewers would be needed even if the parkway were not developed.

The Engineering Department and the Park Department subsequently agreed that the city planning commission should proceed with a preliminary parkway design along the lines suggested by the sketch plan. Upon completion of this somewhat more detailed plan,

these three city agencies would unite in presenting a report to the city council, urging adoption of the parkway plan as the best and most economical way to ease these three pressing needs in an area about to be annexed to the city: (1) an adequate crosstown traffic route; (2) additional recreational areas, (3) proper storm and sanitary sewer routes.

City Council Takes View Trip—Approves Plan

The next step of the city planning commission was to prepare base maps adequate for the preliminary design work. The county engineer supplied a topographic map with ten-foot contour intervals. The Lake City Sewer District, which had developed plans for sanitary sewers through the Thornton Creek valley, provided contour maps with two-foot intervals for parts of the route. Planning commission staff members made field checks of land use from Lake Washington to Puget Sound. All of this information was pulled together in a series of broad strip maps showing contours, buildings and streets at a scale of one inch to 200 feet.

Following the engineering department standards of curvature and grade, a centerline and profile of the parkway was completed from a point near Aurora Avenue to Lake Washington. The design of the remainder of the route, following no watercourse and traversing a largely built-up area, was deferred pending approval of the completed part of the plan.

After review of the preliminary plan, the engineering department, park department and the city planning commission issued a joint report to the city council urging approval of the project, and an early appropriation for acquiring vacant land. To acquaint the councilmen personally with the route of the parkway, the planning commission sponsored a joint commission-council view trip. A sightseeing bus was chartered and in November, 1952, a large group of civic officials viewed the six-mile route. Many stops were made for close observance, and the city engineer, park superintendent and planning director pointed out various aspects and advantages of the projected parkway.

On December 2, 1952, the city council passed the following reso-

lution: "Be it resolved by the City Council of the City of Seattle: That it is the intention of the City Council to approve a comprehensive plan for a multiple purpose crosstown parkway between Matthews Beach and Carkeek Park, including appurtenant parks, and to proceed as expeditiously as possible to acquire the lands and property necessary for a multi-purpose right-of-way as indicated on the attached plan entitled "Proposed Crosstown Parkway" and to appropriate necessary funds therefor and for more detailed engineering studies for parkway and sewer locations, and give consideration to the approval of that portion of the proposed route between Licton Springs and Carkeek Park yet to be determined by the City Planning Commission in cooperation with the Engineering and Park Departments."

Soon the council granted the city engineering department $40,000 for the detailed parkway studies.

Features of Design

On April 23, 1953, engineering crews took to the field and commenced surveying the entire route as outlined in the preliminary plan. The complexity of this task was heightened by the fact that the area recently annexed to the city had never been accurately mapped. From the information gathered by the field crews, a map with two-foot contour interval showed the exact location of all structures. Detailed design was carried forward on this one-inch to 100-foot scale map.

The route will be limited access over its entire six and one-half mile length. The basic right-of-way is 150 feet wide; this will be widened where suitable vacant and adjacent land exists. The parkway will pass under ten north-south arterials and over one. Full or partial traffic interchange will be made with nine of these arterials. The two 24-foot roadways will be separated by a 20-foot median strip. Through the narrowest portions of Thornton Creek valley the roadways will be on different levels, with a maximum differential of about 10 feet. The grade attains a maximum of 7 percent and is much less throughout most of the route. The minimum radius of horizontal curvature is 900 feet.

The portion of the parkway between Bothell Way and Holman Road will be heavily used as a distributor street, transferring traffic from one north-south arterial to another. It will be especially important as a feeder route to and from the future state freeway. The parkway will bring people to the Northgate regional shopping center from all over the North End. If a second bridge across Lake Washington should be built from Sand Point, as proposed by the city planning commission, the parkway will serve as one of its most important western approach routes. It will, of course, serve the needs of many people wishing to travel between the east and west sections of the North End. In addition, scenic features of the parkway should generate much pleasure traffic, particularly on summer weekends.

Parks Proposed Along Route

The scenic features of the route as suggested on the preliminary plan include seven parks, two already city-owned. The Puget Sound terminus of the parkway is the existing 150-acre Carkeek Park. This rugged wooded area is virtually undeveloped, but the city council has approved a $337,000 long-range development program and appropriated funds to carry out its first phase.

Ultimate park department plans include picnic grounds, play areas, bathing beach, riding academy, bridle paths, rifle range, shore restaurant and wild areas. Also included in the approved plan is development of a suitable access road which will actually be the westernmost mile of the proposed crosstown parkway. The park department is negotiating for acquisition of an 18-acre ravine through which the access road will be built.

Traveling east from Carkeek Park the parkway will pass through a residential area, with the next park—Licton Springs—about two miles from Puget Sound. This 7-acre tract is proposed as a small landscaped area, a feature of which might be Licton Mineral Springs once used for medicinal purposes. The third park is a thirty-three-acre vacant tract just south of Northgate. Part of this area will be consumed by traffic interchanges, but a wooded slope can be developed with trails and picnic area—while a neighborhood playground is planned eventually to flank this park.

From Northgate to Lake Washington the parkway closely follows Thornton Creek. It passes through an eighteen-acre tract, much of which is beautifully wooded, tentatively designated as Densmore Park. Trails, picnic area, and a small playground are possible features of this park. Farther east, between 15th Avenue Northeast and Bothell Way, the parkway passes through the narrowest portion of the valley. Here the roadway is being designed to preserve the beauty of the forest on the steep hillside south of the creek.

East of Bothell Way the parkway passes through the nine-hole Meadowbrook Golf Course, and thirty-seven acres of this land is proposed for a public park. The area is extremely attractive at present and is adjoined by a new junior high school. A short distance east the parkway bisects a forty-five-acre area proposed to be Matthews Heights Park. Part of this area is hilly and wooded and part level and open. Development of trails, play areas and possibly a day camp appear logical.

The last park is Matthews Beach—eastern terminus of the parkway fronting on Lake Washington. This nine-acre area, already owned by the city but as yet undeveloped, will be used mostly for a bathing beach, bath house and parking area. The fate of Thornton Creek, which much of the route parallels, is undecided. The stream is heavily polluted, but sewering its drainage area should alleviate this condition. It is increasingly subject to flooding as its drainage basin develops with buildings and streets, increasing peak runoffs. No doubt storm sewers will be provided to carry flood waters, but planners hope that an attractive surface stream can be maintained along least two miles of the parkway.

The Future of Seattle's Crosstown Parkway Project

Public reaction to the parkway project has been good. Community groups, newspapers and individuals have hailed it. However, completion of the parkway appears to be a number of years away. A rough estimate of the total cost is ten million dollars, including two or three million for right-of-way acquisition; and no such sum will be available in the near future. Too much delay might be disastrous since homes are being built on vacant land adjacent to and in the

Seattle Times photo

Eastern Portion of Crosstown Parkway

Seattle Times photo

Western Portion of Crosstown Parkway

parkway right-of-way. The tracts proposed as Meadowbrook and Matthews Heights Parks may both be subdivided and developed before long. Therefore, the City of Seattle is seeking a way to obtain funds so the several hundred thousand dollars worth of vacant land, in the parkway at least, may be purchased.

The parkway proposition, with other thoroughfare proposals for Seattle, may be on a general obligation bond issue submitted to the voters this year.

Several bond issues have been rejected in Seattle since 1950. Issues for a new central library, branch libraries, civic arts center site, acquisition of county parks, and improvement of city parks all failed at the polls. Thoroughfare needs are so pressing and so readily apparent to the average citizen that city officials believe a bond issue proposing thoroughfare improvements in all major sections of the city will be approved.

Once the vacant land is acquired the city can start a long-range scheme to acquire other properties and develop the parkway, using general revenues, gas tax funds and perhaps additional bond issues. This parkway should some day stand beside the Lake Washington Floating Bridge and the Alaskan Way Viaduct as Seattle's unique accomplishments in the field of modern traffic accommodation. There can be no doubt that it will be, as stated by Seattle's city council, a "great and enduring asset" to the metropolis of the Pacific Northwest.

A Résumé and Some Implications of a Canadian Parking Survey

NOEL DANT, M.R.P., M.ARCH., M.T.P.I.

Mr. Dant was born in London, England, and was educated in Britain and the United States, attending London, Edinburgh, Yale and Harvard Universities. He was awarded six degrees in city planning and architecture during this period as well as being the recipient of five medals, two scholarships and two traveling fellowships. He is an Associate of the Royal Institute of British Architects, and a Member of the Town Planning Institute of Great Britain. Mr. Dant has been Town Planner for the City of Edmonton, Alberta, since 1949.

THE Town Planning Department of Edmonton, since its inclusion as a separate department in the city administration late in 1949, had been increasingly concerned with the congestion of downtown traffic and the lack of parking facilities there, similar to those of any comparable or large American city. Concern was further deepened by the knowledge that despite varied attempts in many cities on this continent, mostly piecemeal, to cope with this not unusual situation, very few if any really worthwhile solutions had been proposed to prevent, cure, or concertedly attack the parking problem.

Public reaction to this lack of parking facilities in Edmonton in 1949 was lukewarm and as a coordinative voice of opinion it did not grow much warmer in the interim; an occasional protest appearing in the local papers and constant grumblings amongst acquaintances were the rule. Hence, not surprisingly, the different city councils of Edmonton year by year were not over-anxious to consider the matter specially, possibly because any solution would involve the expenditure of still more capital in a city whose debt per capita is probably one of the highest in the world.

To awaken interest among the city commissioners and city aldermen, the town planner presented to them a series of reports early in 1951 explaining some of the fundamentals of traffic as a means of

BASIC M

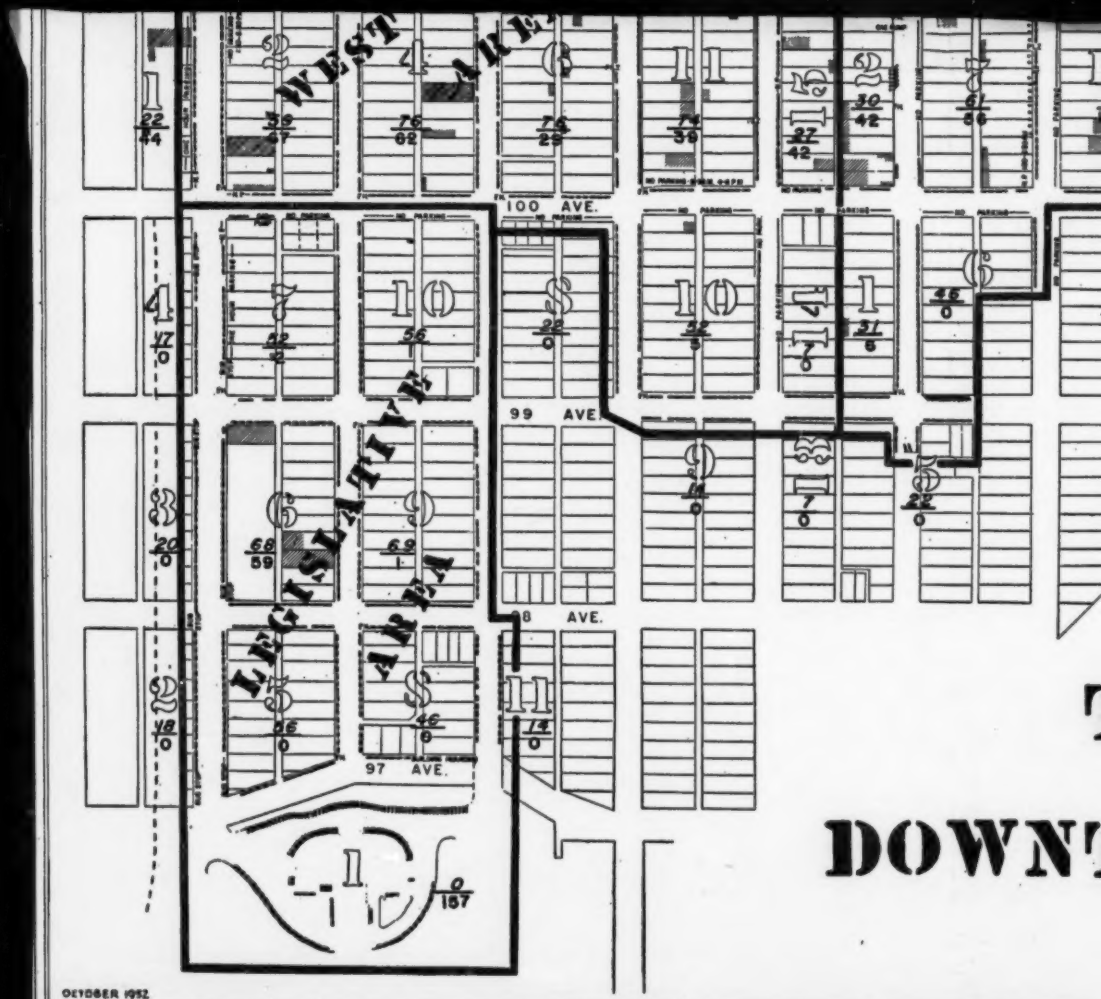
104 AVE.
103 AVE.
102 AVE.
JASPER AVE.
WAREHOUSE
CENTRAL
109 ST.
108 ST.
107 ST.
106 ST.
105 ST.
104 ST.

MAP

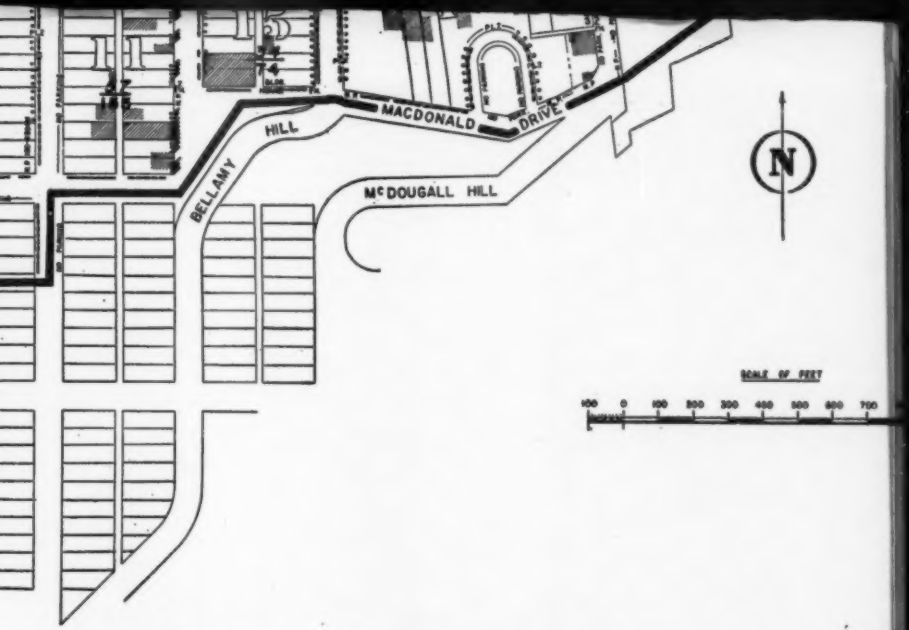
CENTRAL MAIN
JASPER AVE.
101 A AVE.
104 ST.
103 ST.
102 ST.
101 ST.
100 ST.

NOTATION

UNITS OF CURB PARKING SPACE (PARALLEL) ____ UNMETERED
METERED
UNITS OF CURB PARKING SPACE (ANGLE) ____ UNMETERED
METERED
CROSSINGS AND DRIVEWAYS ____ BLANK
TRUCK LOADING ZONES ____ T.L.Z.



OCTOBER 1952



THE CITY OF E

WNTOWN PARKING

THE CITY OF EI

DOWNTOWN PARKING

CROSSINGS AND DRIVEWAYS ..... BLANK

TRUCK LOADING ZONES ..... T.L.Z

PASSENGER LOADING ZONES ..... P.L.Z

NO PARKING ZONES

- RED CURB ..... NO PARKING
- TAXI STAND ..... TAXI
- GAS PUMPS ..... GAS PUMP
- BUILDING HOARDING ..... BLDG HOARDING
- THEATERS ..... THEATER
- BUS STOP ..... BUS STOP
- FIRE HYDRANT ..... F.H.

GENERAL LOCATION OF OFF STREET PARKING AREAS ....

BOUNDARIES OF AREAS .....

NO. OF ON-STREET UNITS IN BLOCK 123

" " OFF- " " " " 123

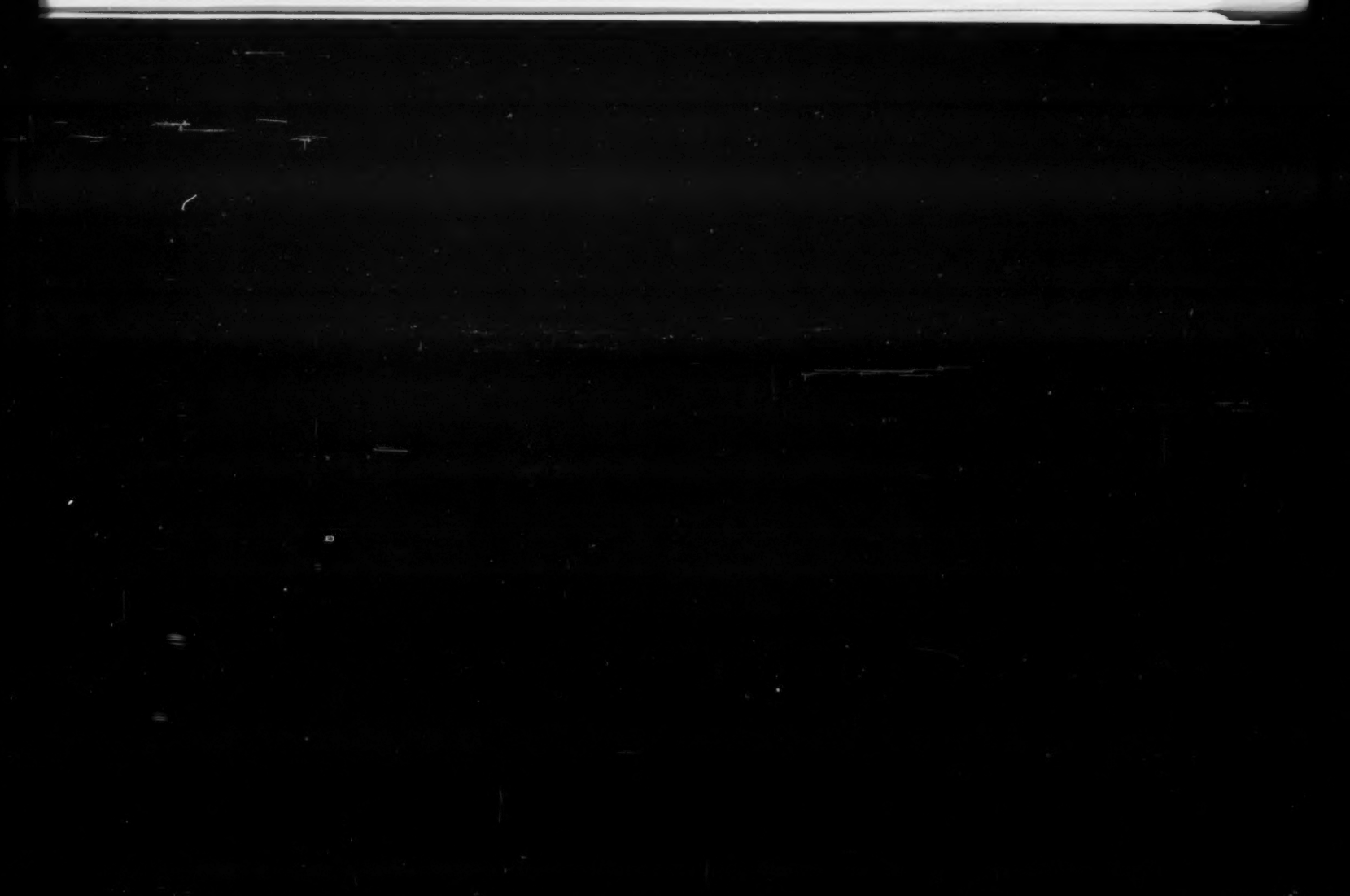
FEET

500 600 700 800 900 1000

EDMONTON

G SURVEY 1952

THE CITY OF EDMONTON DOWNTOWN PARKING SURVEY
TOWN PLANNING DEPT. SURVEYED JUNE/OCT., 1952.



transportation and as a public service.[1] The first of such reports entitled "A Pattern for Parking" treated with, as a continuing theme, the origin of traffic, its nature and effects on modern city structure, taking into consideration each separate land use and arguing for a particular kind of parking requirement needed for each such use.[2] Naturally, the downtown area as the general "central use" was treated the most elaborately and included a digression to explain the way in which traffic operation and congestion starts and continues in any one typical weekday: detailed effects and implications for every hour of the day until decongestion has occurred, evening amusement traffic abated and the day finished.

An important addition in this report included paragraphs on the responsibility of city authorities with regard to parking. In my opinion, local authorities show a general tendency to ignore or deny any responsibility when considering parking plans. Edmonton was no exception. The erstwhile feeling was that types of building which by their specific operation or business engendered a need for parking were themselves responsible for seeing that their patrons and customers were provided for; otherwise the patrons would go where their convenience was accommodated. This thinking would tend to strengthen any decentralizing trend which, though not evil if taken by degree, could if unchecked be the germ to start downtown obsolescence and its inevitable loss of tax and function. Some responsibility by the local authority is therefore implicit and a negative attitude regarding this is to be deplored as self-destructive and suicidal.

Subsequent to the presentation and debate on "The Downtown Parking Survey" the city council of Edmonton has gone on record as agreeing to the responsibility to supply short-term parking (up to one hour, although certain two-hour and all-day parking areas have recently been supplied also), but not to be responsible for long-term

[1] These reports included "A Pattern for Parking," "The Parking Problem and its Relationship to the Highway," "General-Use Traffic Studies," and "Specific-Use Traffic Studies." They were edited and published as "The Nature of Parking and Traffic" along with "The Downtown Parking Survey—1952" early in 1953 and are obtainable from the office of the Town Planner, Civic Block, Edmonton, Alberta, at $3.00 per set.

[2] Some of the sub-titles of this report include: Parking in Rural Areas, Urban Areas, for Special Buildings in Residential Areas, Wholesale-Warehouse Areas, Light and Heavy Industrial Areas, Railroad Shops, Freight and Passenger Terminals, Commercial Areas, and so on.

parking (three hours or more). This stand of Edmonton's top executives may of course be modified in years to come, but this is their present attitude.

The concluding statement in "A Pattern for Parking," proposed a detailed program of what needed to be known about the total parking situation downtown before remedial measures could be recommended for the council's decision and adoption.

Parking Surveys Recommended in 1951

The four reports, later included in "The Nature of Parking and Traffic," were presented regularly and separately in succeeding months early in 1951 to the city council and together, particularly with the proposed program, kept the parking problem constantly before the council's and city commissioners' attention until they were stimulated sufficiently to endorse the idea of undertaking a full-blooded and comprehensive parking survey. The town planning department was directed to embark immediately on this project. Terms of reference were simply those statements in the concluding observations of the report relating to a proposed programme of study;

(a) A survey of existing parking facilities.
(b) A survey of existing parking habits.
(c) Determination of existing parking classifications.
(d) An estimate of available curb parking space.
(e) An estimate of short-term parking requirements.
(f) Disposition of curb space for short-term parking.
(g) Existing off-street areas available for off-street parking.
(h) Disposal of long-term parking, etc. etc.

At this time in 1951 the town planning department had been in existence only two years and had accumulated a staff of some fifteen personnel—quite a large office for such a department in Canada where town planning interest and administration have been slow and ineffective compared to Great Britain and the United States. However, in 1950 the city council of Edmonton had agreed to adopt a modified version of the British interim development method of

planning and in 1952 the department was finding it uphill work to get all the public support for such comprehensive planning measures waiting to be implemented. After five years' operation we can now say that town planning has come to stay in Edmonton and is supported by almost all organized groups, particularly by successive city councils themselves.

Some fruits of the early groundwork are now being completed on the land itself, the effect of which has immeasurably added to an otherwise fickle public support of the movement. In 1952 the department was working on the city's general development plan at full pressure, having started from scratch in 1950. It was also attempting to cope with an unprecedented flood of building applicants, which finally resulted in a record year for the city in total value of building permits. This has only been surpassed with $55,000,000 worth of building permits for 1953. We could ill afford to take staff away from their main work to do this parking survey, which is one of those special projects that town planning departments are plagued with. Further, no special appropriation was made available for this survey work, and existing departmental funds allocated for other uses had to be used under sacrificial conditions.

A team of five was separated from the main body of the department, comprising an assistant planner, two researchers who did most of the field work and two compilers who did most of the drafting work for the report. This small team worked entirely on the survey and report to the exclusion of their regular duties from June to October, 1952 and from 8:30 a.m. to 10:00 p.m., Sundays excepted. Among many interesting things discovered in this survey, perhaps the most surprising was that at the completion of the survey the field workers who did their checking work entirely on foot had walked a distance more than double the mileage from Edmonton to Calgary and back (over 400 miles).

Summary of Survey Method

Details of the method used for the survey, facts ascertained from it, and conclusions drawn from these facts with suitable recommendations, may be found in full in the published report and survey. How-

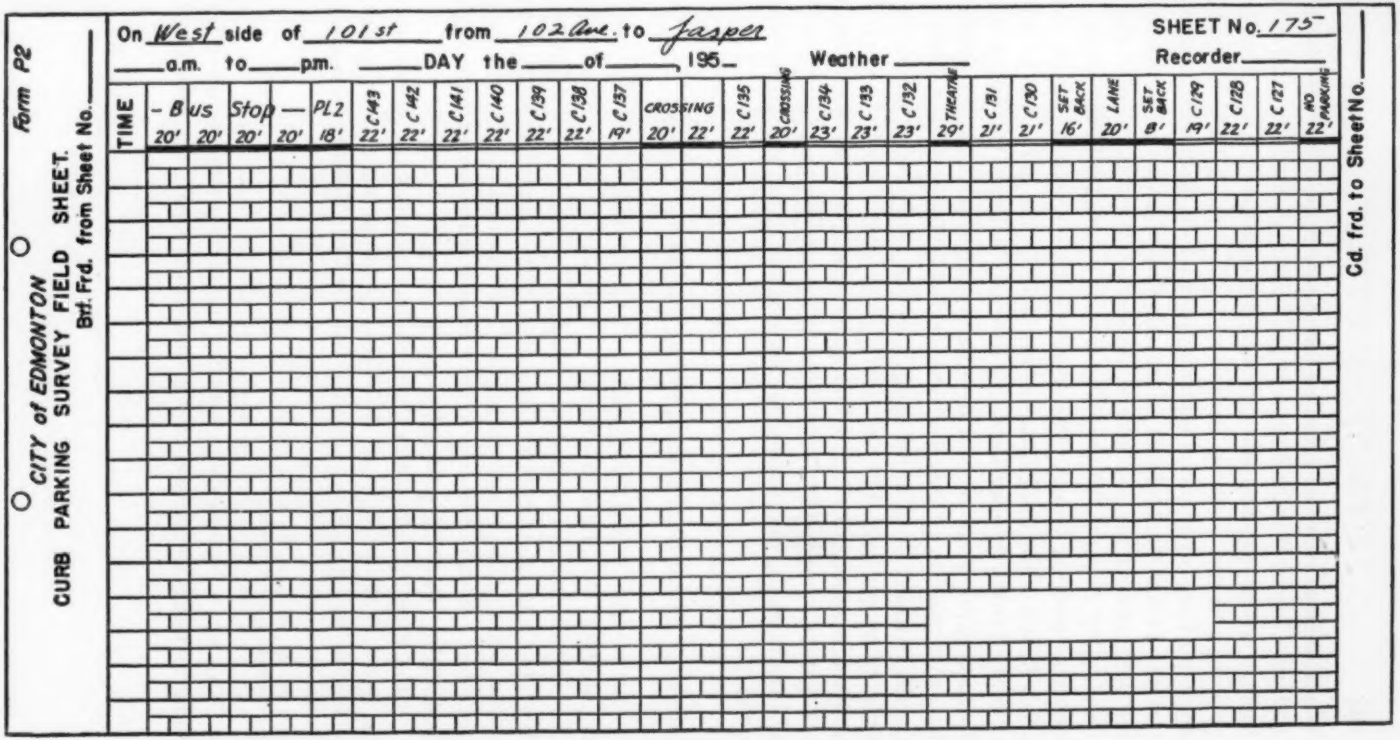
ever, a short summary of the method is given below the better to understand the reaction and partial implementation of the report by the city council. The report defines in detail the methods used to carry out the various studies in order that permanent records will be available should it be necessary for certain studies to be repeated in the future and identical procedures adopted then for insuring true comparisons.

The downtown area itself, always an amorphous area in any city, was first strictly defined in extent. As usual, there were areas within this district in which uses of like kind tended to congregate. Accordingly the defined downtown area was broken down again into five sub-areas based partly on geographic location within the downtown area and partly on dominant use. Findings from the individual sub-areas would therefore tend to be more perfect than if the whole downtown area were treated as a larger single unit.

Owing to dominant use two areas in the city could be included in the downtown area: one in which buildings of governmental and administrative nature are concentrated, and the other in which for years there has been a remarkable stability of warehouse-wholesale building, although each of these areas has small pepperings of other uses within them. The sub-areas of the whole downtown district were therefore clearly defined as the east central area, the central business area, the west central area, the central warehouse-wholesale area and the legislative area. Identical methods of survey were used in each of these five sub-areas, but the facts found were naturally quite different one from another.

Survey of Existing On-Street Parking Services:

Of the seven separate studies embracing part of this report, the first was to ascertain the amount of parking space available at the curbside. There was nothing unusual or glamorous in this study. The total curb footage was measured block by block in each of the five sub-areas and the footage devoted to each particular curbside use duly noted on a field sheet, illustrated in Figure 1 below:



CITY of EDMONTON

CURB PARKING SURVEY FIELD SHEET.

Form P2

Brt. Frd. from Sheet No._____

On West side of 101 st from 102 Ave. to Jasper SHEET No. 175

____a.m. to____p.m. ____DAY the____of____, 195_ Weather_____ Recorder_____

TIME	- Bus 20'	20'	Stop 20'	— 20'	PL2 18'	C143 22'	C142 22'	C141 22'	C140 22'	C139 22'	C138 22'	C137 19'	CROSSING 20'	22'	C135 22'	CROSSING 20'	C134 23'	C133 23'	C132 23'	THEATRE 29'	C131 21'	C130 21'	SET BACK 16'	LANE 20'	SET BACK 8'	C129 19'	C128 22'	C127 22'	NO PARKING 22'

Cd. frd. to Sheet No._____

FIGURE 1. Typical Field Sheet for On-Street Parking Services.

Where meters had been installed, this was simple. Where no meters had been installed and no painted guide lines existed, 21 to 22 curb footage where parking was permitted was allowed for a parallel parking stall and 11 to 12 feet for an angle parking stall. No right-angle parking is permitted on-street in this city. Each stall or space was given a number and this information together with curb footage for all other curb uses was placed in the top column of the field sheet reading left to right. This field sheet was later used in the study of on-street parking habits. The interesting thing elicited from this study is that of the total curb footage in all blocks only some 68 percent of all curbs were available for parking; and even this figure will be successively reduced year by year as curb space becomes needed for other mandatory uses. If street parking is changed from angle to parallel parking the number of vehicles that can be accommodated is reduced by one-half. The remaining 32 percent of curb space available was used for bus stops, driveway entrances, fire hydrants, corner safety clearances, service lanes, truck and passenger unloading zones, railway crossing, taxi stands, gas pumps, entrances, and no-parking zones.

Survey of Existing Off-Street Parking Facilities:

An inventory field sheet (Figure 2) was provided for every existing off-street parking area whether privately or city-owned and various characteristics of each were recorded. From the study it was evident that some motorists are willing to pay a considerable sum to rent private parking near their places of business. Such rents vary from $20 a month down to $2.50 a month. City-owned stalls with heater plug provided, rent at $90 a year.

One of the most important factors affecting private off-street parking is its lack of permanency. A parking lot owner has nothing to prevent him from deciding to use his land for more lucrative purposes.

Speed and Delay Study:

This was a short study to ascertain the average time required for traffic to reach the centre of the downtown area from several se-

Illustration No. #2 **INVENTORY OF OFF-STREET PARKING**

LOCATION _____

_____

LOT(S) AND BLOCK No. _____

OWNER _____

AREA _____

NUMBER OF SPACES _____

TYPE OF SURFACE _____

ARE LANES AND STALLS MARKED? _____

CHARGES PER DAY, WEEK OR MONTH _____

USES (CUSTOMER, PRIVATE EMPLOYEE, ETC.) _____

LANDSCAPED OR IMPROVED _____

COMMENTS _____

FIGURE 2. Field Sheet for Off-Street Parking Services.

lected suburban points three miles distant from the downtown focus. The average speed of traffic into the downtown area was found to be 18.8 miles per hour.

Parking and Walking Time Loss:

This study was to ascertain the amount of time likely to be wasted by a driver trying to find a parking space and walking therefrom to his point of destination. His time loss was then compared to the time factor found in the speed and delay study. The typical field sheet used is shown in Figure 3.

Peak parking occurred from 11:00 to 11:30 A.M., 2:30 to 3:30 P.M. and 8:30 to 9:30 P.M. The highest recorded time losses were 24, 21 and 19 minutes at 9:30 P.M., 3:30 P.M. and 11:00 A.M. respectively. Compared with the speed and delay study a driver can therefore travel approximately six and a half miles in 21 minutes in typical city traffic or almost from one side of the city to the other.

A Study of On-Street Parking Habits:

Perhaps one of the most important of all the studies is that of parking habits. Although this study involved a tremendous amount of repetition and foot-plodding, the results obtained were well worthwhile. The field sheet (Figure 1) was used and a visit paid to every stall every thirty minutes throughout the day and throughout the week, at each trip noting the registration number of the car parked there, if any. In particular, the petty violations of overtime parking, feeding the meter, and absence of payment were brought to light. Results were analyzed under five separate headings:

(a) Turnover rate.
(b) Duration of parking.
(c) Effects of overtime parking.
(d) Areas of saturation.
(e) Violations.

A completed sample field sheet is shown in Figure 4. A closer examination will show, for instance, that in stall C143 car number

CITY OF EDMONTON DOWNTOWN PARKING SURVEY

PARKING AND WALKING TIME LOSS

Recorder — K.P. Weather — Clear and Dry Destination — X's Store

1 Day	2 Date	3 Time A.M.	3 Time P.M.	4 Place of Parking	5 Time Lost Parking (mins.)	6 Time Lost Walking (mins.)	7 Walking Distance (feet)	8 Remarks
Mon.	5/5/52	9:00		Meter D-2	2'-45"	0'-58"	300'	
"	"	11:30		" E-105	6'-37"	2'-13"	600'	
"	"		1:30	" D-138	11'-08"	0'-50"	270'	
"	"		3:00	" E-130	2'-30"	3'-10"	1000'	
Tues.	6/5/52	9:30		" C-55	13'-45"	2'-09"	540'	
"	"		3:00	N. side 102 Ave. 100' W. of 99 Street	14'-06"	3'-45"	1150'	

Total Time lost - - _____

Average time loss per journey - - - - - - - - - - - - - - _____

Average speed for 3 miles journey to point of destination - - _____

Reduced average speed due to time losses 5 and 6 - - - - - _____

FIGURE 3. Field Sheet in Parking and Walking Time Loss Study.

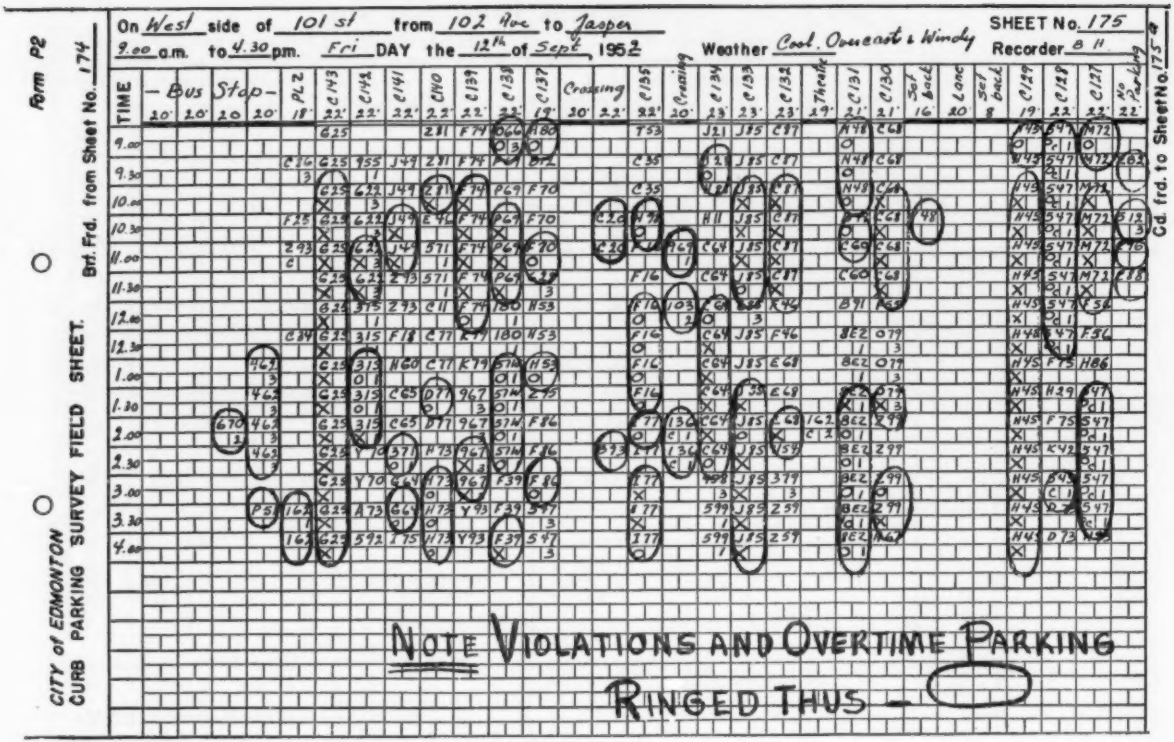


FIGURE 4. Field Sheet for Curb Parking Survey.

FIGURE 4. Field Sheet for Curb Parking Survey.

GENERAL

A careful survey has previously been made of all curb space uses in each block to be covered by the survey. This information has been transferred to the top spaces on Form P 2. For example—the first left hand space will generally represent the first ten feet from the intersection in which parking is prohibited by By-law. Where the space is controlled by a Meter the Meter number is shown. Units of curb space have also been allocated on the form for Bus Stop Zones, Driveways, Fire Hydrants and so on. (Normally these columns should remain blank on the form unless observing a parking violation which of course should be recorded.)

The top line of spaces, in effect, represents a "written plan" of the types of curb space to be found in each block, and the form, when completed, is intended to show how these units of curb space have been used for parking at one-half hourly periods, and to what extent so used. Daytime period 9:00 a.m. - 4:30 p.m.

PROCEDURE

The Survey Form P2 is designed to cover each street or avenue in each block at intervals of one-half hour throughout the survey period and the recorders route will be allocated so as to allow for a one-half hourly tour of a particular area.

Against each one-half hour in time, there are three spaces in each unit column which are used for recording thus:

(a) **Top Space.** License Numbers.

Record the last three digits (or letters) of the license number of the vehicle occupying the curb space unit in each one-half hour period.

(b) Lower **Left hand** square
Record type of violation as per code:

No	Mark	
O		Legally parked.
X		Meter shows overtime disc.
C		Overtime paid on meter.
=		Parked more than eighteen inches from curb.
A		Improperly parked in marked stall.
P		Angle parked in parallel stall.
D		Parallel parked in angle stall.
		Double parked.

(c) Lower **Right hand** square
Record type of vehicle as per code:

No	Mark	
1		Passenger vehicle with Alberta license.
2		Passenger vehicle with other license.
3		Taxi
4		Light truck (4 wheel).
5		Heavy truck (6-10 wheel).
6		Truck-trailer combination.
		Miscellaneous vehicle.

Instructions for Recording Data on Curb Parking Field Sheet.

–G25 arrived at 9:00 A.M., paid a nickel for one hour and thereafter until 4:00 P.M. fed the nickel every hour. On the other hand in stall C131 car number —8EZ arrived at 12:30 P.M., paid a nickel, and another nickel was deposited at 1:30 P.M. Thereafter until 4:00 P.M. the parker was guilty of gross overtime without payment.

Turnover Rate:

Based on an average day of seven and a half working hours the average number of times each stall was used throughout the day was arrived at by taking the total length of time curbside stalls were used (in half-hour periods) and dividing this into the total number of vehicles found in each block. The results as shown in Figure 5 reveal the areas most susceptible to repeated overtime parking and also those areas where short-term parking was being used by long-term parkers.

It would appear that the motorist is prepared to pay a $1 fine or more to be able to use a parking space long after its maximum permissible period.

Duration of Parking:

Using the different data gleaned from all field sheets it was found that most of the on-street parking was from one-half to three and a half hours' duration and that the curbside parking space was being abused in certain respects, such as repairing and servicing of vehicles adjacent to garages, etc. Numerous businessmen condemned the practice of persons who occupied curb space outside their premises for long periods on the grounds that it was detrimental to their business.

The Effects of Overtime Parking:

The number of motorists who park overtime was relatively small, but the number of potential parkers eliminated by those motorists was far out of proportion. In a given typical day it was found that if all motorists had not overstayed their legal time, 24

MAP SHOWING DAILY TURNOVER RATES
OF ON-STREET PARKING
Day Taken as 9:00 a.m.–4:30 p.m.
1–2 Vehicles per Day
2–4 Vehicles per Day
4–6 Vehicles per Day
6–8 Vehicles per Day
8 and over Vehicles per Day

FIGURE 5. Parking Survey Shows Turnover Rates in Five Downtown Sub-areas.

percent (or 4,252) more parkers could have been accommodated downtown. In decreasing turnover rates, other motorists are reluctant to move their cars from their stalls and look for other stalls for the next business meeting and consequently are lured into the army of overtimers.

Areas of Saturation:

For purposes of remedy this was a most important study. The method employed was to total the number of curbside parking stalls for each block and also total the number of stalls for each half hour per block. The percentage saturation (i.e. the percentage of stalls in use) was found by division. The half-hourly percentages were totalled and averaged block by block for the day, then grouped into 20 percent intervals and shown pictorially as in Figure 6.

The greater proportion of the central area has extreme saturation, and low saturation areas are too far distant from the central business area to ease the problem.

Violations:

The last study in connection with parking habits was the problem of violations. Apart from the different kinds of parking violations (19 in all) and the number of times each kind was perpetrated, it was noted that violations in themselves did not give a true indication of parking conditions. It is not suggested that as a group motorists deliberately violate. Rather it is inevitable when serious parking deficiencies exist that the number of violations will be found correspondingly high.

Study of Off-Street Parking Habits:

The next to last major study was to assess off-street parking habits. Generally speaking, such parkers can be classified as long-term parkers, chiefly businessmen and shoppers. Those businessmen who merely drive to and from work appear to be satisfied with an all-day stall not more than two blocks away. Doctors and real

MAP SHOWING AVERAGE DEGREE OF SATURATION
Average from 9:00 a.m.–4:30 p.m.
0%–20% of Stalls in Use
20%–40% of Stalls in Use
40%–60% of Stalls in Use
60%–80% of Stalls in Use
80%–100% of Stalls in Use

FIGURE 6. Central Business Area Shows High Saturation Percentage.

estate agents who have several business trips a day like to be able to park in the same block, and shoppers appear to spend more when able to secure an off-street stall in preference to an on-street stall. Trade derived from off-street parking areas has high value to nearby stores.

Study of Parking Demands:

Perhaps the most important study—on which most of the proposals were ultimately based—was that of parking demand. The demand figure when obtained for each block and compared with the total number of stalls available in that block (on and off-street) reveals the deficiency of surplus per block. First, it was necessary to ascertain how people came downtown. Forms similar to Figure 7 were sent to leading firms of each major type of business and as customers or clients arrived at the premises the forms were filled in by the office staff.

Also, samples were taken by field men interviewing passers-by at several important intersections downtown. Of business firms approached 71.6 percent were able to make a return, and 9.6 percent were prevented because of too rapid customer turnover. Most interesting results were obtained from the larger department stores. Cooperation of business executives was of a high order when it was explained to them that the survey was out to help them and their business. After scrutinizing all such forms (75,000 of them) the results were depicted as in Figure 8.

A group interested in promoting parking facilities thus has essential data at its disposal. It can approach the problem in two ways:

By selecting suitable locations and calculating probable potentialities with regard to number and turnover of vehicles likely to use the facility and thus indicate likely revenue to be derived therefrom; or by selecting an area and computing the number and type of additional stalls needed to satisfy the designing of parking spaces therein.

This method is shown diagrammatically by the overlay above Figure 8.

FORM P.3. City of Edmonton PARKING SURVEY Block No. 18 Sheet No. 22702

Census of Methods of Transportation used by persons visiting Central Downtown Area.

NAME "X" and "Y" ADDRESS 9292 - 99 Street TYPE OF BUSINESS Optometrist

NOTE: Please fill in time of day at ½ hour intervals. 1 = one person Date of Census June 5th, 1952.

TIME		METHOD OF TRANSPORT USED						OWN A VEHICLE	WOULD HAVE USED IT IF ADEQUATE PARKING WAS AVAILABLE	PERIOD OF PARKING REQUIRED			
A.M.	P.M.	WALKED	BUS	TAXI	TRUCK	CAR	OBTAINED A RIDE			½ HOUR	1 HOUR	2 HOURS	3 HOURS & OVER
9:30			///			////				/			///
10:00						/				/			
10:30			/			/				/			
11:00			//			///				//	/		
11:30		//	//										
12:00		///				/				/			
	12:30	//											
	1:00	/	/			/		/	/	/	/		
	1:30		/					/	/	/			
	2:00	/	///			/		/	/	/	/		
	2:30		///			/				/			
	3:00		////			///				//	/		
	3:30		/			//					//		
	4:00		/			//		/	/	//	/		
	4:30	/				/					/		
	5:00	//											
	5:30												

FIGURE 7. Typical Sheet Used in Transportation Method Survey.

Survey Conclusions Summarized

The finished survey and a summary of some of the conclusions drawn from it naturally gave rise to the recommendations. For lack of space, only some of the important conclusions are given below:

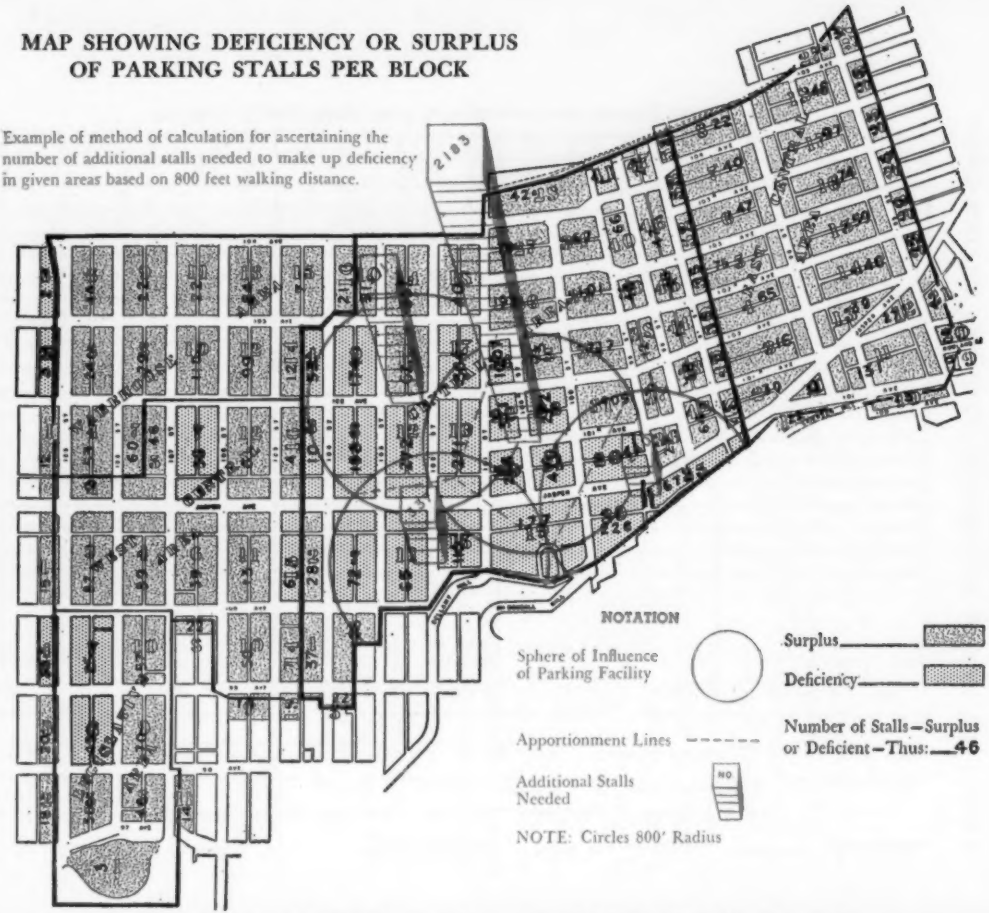

MAP SHOWING DEFICIENCY OR SURPLUS
OF PARKING STALLS PER BLOCK
Example of method of calculation for ascertaining the number of additional stalls needed to make up deficiency in given areas based on 800 feet walking distance.
NOTATION
Sphere of Influence of Parking Facility
Surplus
Deficiency
Apportionment Lines
Number of Stalls—Surplus or Deficient—Thus: 46
Additional Stalls Needed
NOTE: Circles 800' Radius

FIGURE 8. Results of Parking Demand Survey Provided Basis of Ultimate Proposals.

1. In the downtown area parking stalls or spaces were available for less than one-quarter of all Edmonton car registrations. Four thousand additional stalls are essential, subject to no removal of any existing off-street stalls, to satisfy minimum current demand.

2. There never will be a permanent solution found for parking problems at the curbside.

3. There was a high lack of parking for shoppers and a shortage of parking for long-term users.

4. Private enterprise has shown little desire to enter the parking business. Lack of previously known data regarding the parking situation was given as the prime reason.

5. Parking provision up to now has been on a piecemeal basis without real knowledge. Expediency and opinionated reasons are the motive power.

6. Lack of permanency, both in curbside stalls and off-street private areas, will always be a threat to any successful solution.

7. Parking space must be *located* correctly and be of the right *type,* otherwise many stalls will remain empty.

8. Different parking facilities can conflict and operate to one another's detriment. All parking facilities must be carefully considered as *one parking system for the whole area.*

9. Meter feeding must be stamped out.

10. Loss of business due to lack of parking facilities was more important than generally believed.

11. Businesses particularly are likely to cooperate whole-heartedly in a comprehensive parking plan.

12. Because of Edmonton's low temperatures, shoppers will not generally walk farther than 800 feet from stall to destination and long-term parkers, 1,000 feet.

13. Little thought has been given to landscaped and surfaced parking lots nor to encouraged use of off-street parking as a legitimate business.

14. It is vitally essential that the economic health of the downtown area be maintained to prevent loss of revenue through excessive decentralization of business.

15. The premise that parking must be paid for in areas of high demand will have to be generally accepted.

FIGURE 8. Results of Parking Demand Survey Provided Basis of Ultimate Proposals.

Practical Methods Proposed to Council

The proposals offered to the city council comprise some thirty pages of the report. Pressure of space forbids other than a cursory recapitulation.

The city owns a not considerable amount of land in the general downtown area (see Figure 9). Most of it had already been sold prior to the survey. Some of these lots contain run-down houses which reverted to the city by tax default some years ago and the

CITY-OWNED PROPERTY
SUGGESTED AS POTENTIAL PARKING SITES
NOTATION
CITY-OWNED PROPERTY RECOMMENDED TO BE HELD IN RESERVE
CITY-OWNED PROPERTY RECOMMENDED FOR OFF-STREET PARKING DEVELOPMENT
THE CITY OF EDMONTON DOWNTOWN PARKING SURVEY
TOWN PLANNING DEPT.
SURVEYED JUNE/OCT., 1951.

FIGURE 9. Sites in Downtown Edmonton Available for Parking Lots.

city has since collected rent on these premises. It was shown that to lay out these lots as parking areas and meter them would provide the city with a revenue in excess of the rents charged for the houses.

Consequently, by using all available city-owned land downtown some 800 additional parking stalls could be put into use off-street. Many of these have already been implemented and certain of the larger areas have a considerable sprinkling of two-hour and five-hour meters. These areas have since been well patronized and must have eased somewhat the short-term parkers' use of curb stalls by transferrence.

An innovation has been adopted which placed 18-minute meters on the first three metered curb stalls at the ends of certain downtown blocks where parking saturation was shown to be severe. Such meters are coloured brown for easy recognition. The fee for these 18-minute meters is still five cents. This has cut down some of the meter feeding disease. Elsewhere in the recommendations are suggested other practical methods for coping with this plague. It is amusing to note that all stalls in front of the Police Station have been converted to eighteen-minute meters so that parking violators may pay up more promptly!

As mentioned before, the city has tacitly acknowledged its responsibility to supply as many short-term parking stalls as possible. It is to its credit that more than 600 new metered and hard-surfaced stalls have been put into use since the survey was made public.

Based on the information shown by Figure 8 and its overlay, the most important recommendation was to interest the city or private enterprise to construct multi-storey parking garages (in the areas of peak demand) with retail shops on the ground floors to help subsidize the cost of such garages. Subsequently two or three exploratory overtures have been made in this connection, one by the city and two by private finance, but nothing yet has been decided.

Another recommendation was to alter the type of curb parking in different zones from long-term to short-term and also to alter meter rates in areas of peak demand. Both, if enforced, would tend to cut out meter feeding. A paradox in the survey showed that the choicest parking space in areas of high demand on-street was available at a lower rate than off-street private facilities. The justification

of a change in meter rate therefore would be that current on-street rates do not reflect the true value of the convenience of the parking space.

Although the Interim Development Bylaw was adopted in 1950 and a formula enforced for mandatory provision of off-street parking facilities in connection with all new buildings and existing buildings undergoing considerable alteration, the formula has not been taken too kindly by potential new building owners on the plea that to enforce it would make the enterprise financially impossible. This in spite of the very low parking requirements of the formula compared to 180 American cities that were surveyed. I do not think that such piecemeal approach to parking deficiency on the lot basis is a good practical answer.

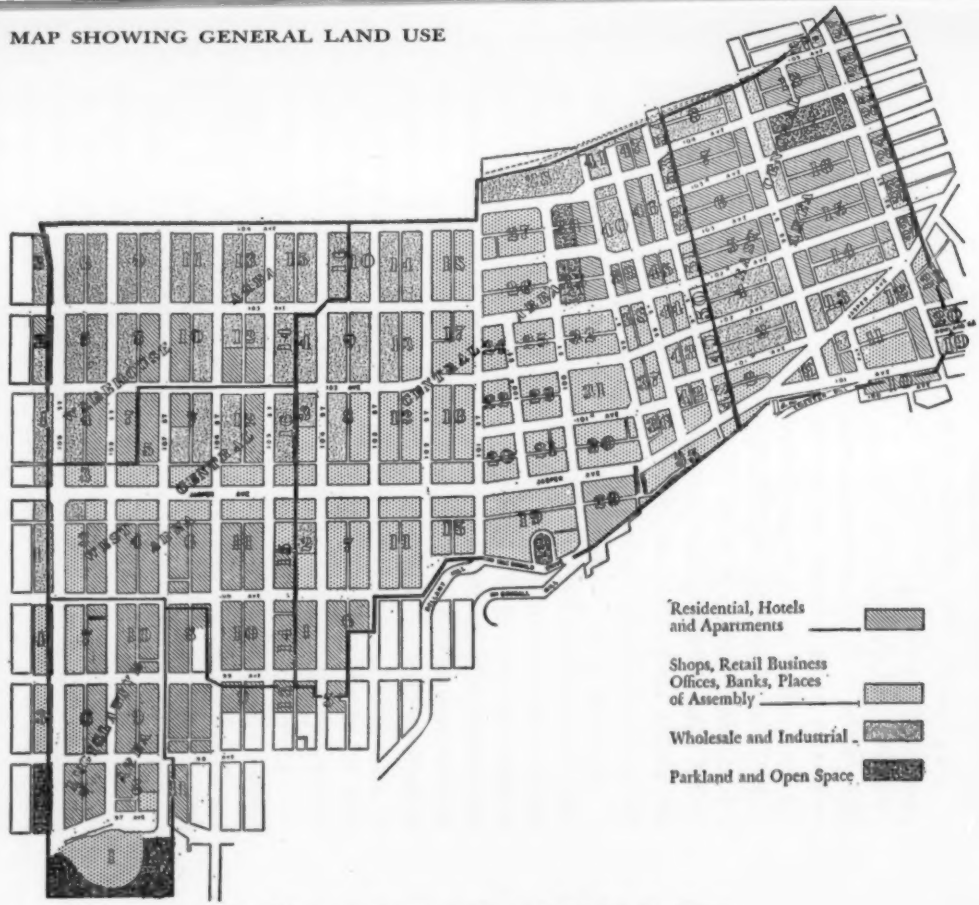
Parking is essentially a group function. A new parking zoning ordinance is what is most needed and proposals for such were recommended. City council has not seen fit to implement this proposal; rather they preferred to carry on the existing 'outdated' (author) formula and to satisfy the pleas of new building owners, a very unwise and shortsighted amendment was made to the Interim Development Bylaw instead. In effect, this amendment gives the mayor and city commissioners non-appealable powers normally given only to an appeal board or vested in the city council itself. In fairness to some city aldermen it must be mentioned that I doubt that many of them knew exactly what was involved when this amendment, which had every indication of being railroaded through the council, was put to them under the excuse of that often misused dictum, "Every application should be treated on its own merits." The effect of this amendment, which has been used several times, is a complete abnegation of all the parking survey stood for, throwing out of the window many of the hard-won facts and substituting therefor opinions and guesses.

Perhaps the most vital of all the proposals was an emphatic recommendation to immediately establish a public parking authority, possibly on a Commission basis, to which *all* parking problems could be referred. One whole chapter of the report deals with the creation of such an authority in detail.

Potential parking demand for as yet unplanned future buildings

MAP SHOWING GENERAL LAND USE

MAP SHOWING GENERAL LAND USE


Residential, Hotels and Apartments
Shops, Retail Business Offices, Banks, Places of Assembly
Wholesale and Industrial
Parkland and Open Space

The Edmonton Downtown Area as Defined in the Survey.

obviously could not be included in the survey as far too many unknown factors are involved. The only way to arrive at an approximate figure for this future demand would be to adopt the British Floor-Space-Index-Method which itself should be incorporated into the proposed parking ordinance.

As a summary of post-action following the publication of the report, several meetings of the city council were held to debate the proposals and the issues thrown up. Some were approved in principle, some in detail, promptly; others were referred to committee or to city commissioners for further study and report. In all only the most minor of the proposals have been implemented. In fact it is doubtful if more than three or four of the aldermen bothered to read the survey cover to cover. Admittedly it was an exhaustive task. A full month was given to each alderman to peruse it and then in succeeding weeks the enthusiasm and interest started to wane after the first flush of publication and reading the report had worn off.

Even still to be deplored is the lack of public response to purchase or even read the report. A modest sum was asked for the set solely to defray printing expenses. Two hundred complimentary copies were circulated to every large city in Canada and to every planning library on the continent as well as copies to many planning departments on this continent and in Britain. Sales, which reached under one hundred sets in Edmonton, actually were far exceeded by sales outside Edmonton. Sets have been despatched to cities in each of the five continents, the largest purchasers being cities and towns in the United States and Great Britain.

Recently however, the Edmonton Chamber of Commerce has formed a small committee to further the idea of establishing a parking authority (which the city council has not done) to which all problems of the parking situation and the implementation of all outstanding proposals in the report can be referred. It is possible that the Chamber (which takes the interests of most businessmen in this city to heart) will succeed where general opinion in its paucity has failed. At least the Chamber promises to keep before city council and the public the knowledge that if aggressive and determined effort is not made soon the situation will degenerate to a point beyond practical recall.

Decentralization of Retail Trade

SAMUEL C. McMILLAN

Professor McMillan is head of the department of marketing and assistant dean of the School of Business Administration at the University of Connecticut. He has directed several community studies dealing with shopping habits in Connecticut. He is a member of the American Marketing Association and currently chairman of their Academic Appointments Committee.

FOR a quarter of a century, a problem in the marketing sector of our economy has been the decentralization of retail trade. That decentralization occurs when sales in the center of the market area become smaller relatively than theretofore; conversely, sales in the remainder of the market area become larger relatively than was heretofore true.

So obvious has been this phenomenon in many of our cities that statistical support has not often been called for and, consequently, not very often been offered. While this article does not cover such decentralization in the United States in detail, it does attempt to look at what has happened to the location of retail trade transactions, particularly in some of our largest cities where the phenomenon of decentralization has been most pronounced.

The Census of Business collects data on retail trade for 168 standard metropolitan areas. The general concept adopted in defining a standard metropolitan area was one of an integrated economic unit with a large volume of daily travel and communication between a central city and the outlying parts of the area. Each of these standard metropolitan areas consists of one or more counties (except for New England where the metropolitan areas have been defined on a town rather than a county basis.)

In addition to collecting retail trade data for the standard metropolitan areas, the Census of Business also collects similar data for the central city within the standard metropolitan area. (1*) With these data available for analysis, it is possible to determine, in any census

* Please see Notes at the end of this article.

year, the percentage of retail trade of the metropolitan area that is transacted within the central city and the percentage that is transacted in the remainder of the area. By comparing the most recent census data (1948) with the previous census year (1939), it is possible to see the change that has taken place in certain cities. Table I contains information on the number of stores and dollar sales volume in 32 standard metropolitan areas with central cities of 250,000 inhabitants or more. In these 32 metropolitan areas, more than 40 percent of the retail sales of the nation are made. The following are some of the observations relevant to decentralization that one may glean from these data when 1948 is compared with 1939:

(1) The number of stores in the 32 metropolitan areas was less by 3.7 percent. In the central cities there was a decrease of 8.6 percent, whereas in the balance of the area there was an increase of 5.7 percent. A combined loss in the number of retail stores of about 10 percent took place in the central cities in 27 areas, while 5 others showed small gains. The central cities showing gains were Birmingham, Dallas, Houston, Memphis and Washington; the average gain was 9.3 percent. The increase in the number of stores in the remainder of these 5 metropolitan areas, however, was greater by 46.7 percent. In five metropolitan areas there was a decrease in the number of stores surrounding the central city.

(2) The dollar sales volume for these 32 metropolitan areas increased by 191 percent. In the central cities this increase was 177 percent as compared with 226 percent for the balance of the area. The increase for the nation as a whole was slightly in excess of 200 percent. In all of the 32 metropolitan areas, the stores in the central city did a smaller percentage of the retail business of the area in 1948 than they did in 1939. The average for all 32 central cities was 68.1 percent.[1] This is a drop of 3.5 percentage points from the average of 71.6 percent in 1939.

The foregoing analysis does not deal specifically with the central business districts within these 32 cities.[2] Nevertheless, most of the

[1] Memphis with 96.4 percent was the city where the greatest percentage of retail sales of the metropolitan area was transacted within the central city; Pittsburgh was the city with the smallest percentage of such transactions, with 44.3 percent.

[2] The term "central business district" is used here in approximately the same sense that the terms "downtown" or "main business district" are ordinarily used.

RETAIL TRADE IN 32 STANDARD METROPOLITAN AREAS WITH CENTRAL CITIES OF 250,000 INHABITANTS OR MORE[1]

STORES AND SALES FOR CENTRAL CITY AND BALANCE OF METROPOLITAN AREA: 1939 AND 1948[2]

Metropolitan Area	Stores		Sales (000)		Percent of Total: Stores		Percent of Total: Sales		Percent change 1939 to 1948: Stores	Percent change 1939 to 1948: Sales
	1939	1948	1939	1948	'39	'48	'39	'48		
Metropolitan Areas with Central Cities of 250,000 inhabitants or more, total	*656,499*	*632,196*	*$19,218,121*	*$55,979,939*	*100.0*	*100.0*	*100.0*	*100.0*	−3.7	+191
Central Cities	432,707	395,667	13,751,966	38,138,296	65.9	62.6	71.6	68.1	−8.6	+177
Balance of Areas	223,792	236,529	5,466,155	17,841,643	34.1	37.4	28.4	31.9	+5.7	+226
New York-Northeastern New Jersey Metropolitan Area	*182,002*	*170,747*	*4,875,169*	*12,618,982*	*100.0*	*100.0*	*100.0*	*100.0*	−6.2	+159
New York City	115,219	103,765	3,192,594	8,000,012	63.3	60.8	65.5	63.4	−10.0	+151
Balance of Area	66,783	66,982	1,682,575	4,618,970	36.7	39.2	34.5	36.6	+0.3	+174
Chicago Metropolitan Area	*65,586*	*61,881*	*1,996,204*	*5,970,537*	*100.0*	*100.0*	*100.0*	*100.0*	−5.6	+199
Chicago	47,832	43,466	1,514,829	4,336,330	72.9	70.2	75.9	72.6	−9.1	+186
Balance of Area	17,754	18,415	481,375	1,634,207	27.1	29.8	24.1	27.4	+3.7	+240
Los Angeles Metropolitan Area	*46,776*	*48,765*	*1,364,609*	*4,689,586*	*100.0*	*100.0*	*100.0*	*100.0*	+4.3	+244
Los Angeles	24,535	22,945	782,842	2,340,388	52.5	47.1	57.4	49.9	−6.5	+199
Balance of Area	22,241	25,820	581,767	2,349,198	47.5	52.9	42.6	50.1	+16.1	+304
Philadelphia Metropolitan Area	*47,356*	*45,423*	*1,156,425*	*3,335,541*	*100.0*	*100.0*	*100.0*	*100.0*	−4.1	+188
Philadelphia	30,099	28,163	766,622	2,108,988	63.6	62.0	66.3	63.2	−6.4	+175
Balance of Area	17,257	17,260	389,803	1,226,553	36.4	38.0	33.7	36.8	0.0	+215
Detroit Metropolitan Area	*28,163*	*27,967*	*904,391*	*3,002,039*	*100.0*	*100.0*	*100.0*	*100.0*	−0.7	+232
Detroit	19,844	18,096	665,565	2,074,923	70.5	64.7	73.6	69.1	−8.8	+212
Balance of Area	8,319	9,871	238,826	927,116	29.5	35.3	26.4	30.9	+18.6	+288
San Francisco-Oakland Metropolitan Area	*23,938*	*25,123*	*749,436*	*2,361,192*	*100.0*	*100.0*	*100.0*	*100.0*	+5.0	+215
San Francisco-Oakland	16,493	15,606	564,419	1,576,748	68.9	62.1	75.3	66.8	−5.4	+179
Balance of Area	7,445	9,517	185,017	784,444	31.1	37.9	24.7	33.2	+27.8	+324
Boston Metropolitan Area	*27,275*	*23,864*	*941,269*	*2,217,037*	*100.0*	*100.0*	*100.0*	*100.0*	−12.5	+136
Boston	11,817	9,817	490,396	1,078,972	43.3	41.1	52.1	48.7	−16.9	+120
Balance of Area	15,458	14,047	450,873	1,138,065	56.7	58.9	47.9	51.3	−9.1	+152

Boston Metropolitan Area	*27,275*	*23,864*	*941,269*	*2,217,037*	*100.0*	*100.0*	*100.0*	*100.0*	−12.5	+136
Boston	11,817	9,817	490,396	1,078,972	43.3	41.1	52.1	48.7	−16.9	+120
Balance of Area	15,458	14,047	450,873	1,138,065	56.7	58.9	47.9	51.3	−9.1	+152
Pittsburgh Metropolitan Area	*22,971*	*23,252*	*697,016*	*1,967,604*	*100.0*	*100.0*	*100.0*	*100.0*	+1.2	+182
Pittsburgh	7,875	7,515	337,312	871,194	34.3	32.3	48.4	44.3	−4.6	+158
Balance of Area	15,096	15,737	359,704	1,096,410	65.7	67.7	51.6	55.7	+4.2	+205
St. Louis Metropolitan Area	*21,059*	*19,750*	*515,733*	*1,556,067*	*100.0*	*100.0*	*100.0*	*100.0*	−6.2	+202
St. Louis	13,161	11,650	353,860	978,298	62.5	59.0	68.6	62.9	−11.5	+176
Balance of Area	7,898	8,100	161,873	577,769	37.5	41.0	31.4	37.1	+2.6	+257
Cleveland Metropolitan Area	*17,418*	*15,555*	*524,073*	*1,520,224*	*100.0*	*100.0*	*100.0*	*100.0*	−10.7	+190
Cleveland	13,814	11,759	420,426	1,175,139	79.3	75.6	80.2	77.3	−14.9	+180
Balance of Area	3,604	3,796	103,647	345,085	20.7	24.4	19.8	22.7	+5.3	+233
Washington, D. C., Metropolitan Area	*9,136*	*10,135*	*482,503*	*1,480,835*	*100.0*	*100.0*	*100.0*	*100.0*	+10.9	+207
Washington, D. C.	6,893	7,074	402,768	1,107,732	75.4	69.8	83.5	74.8	+2.6	+175
Balance of Area	2,243	3,061	79,735	373,103	24.6	30.2	16.5	25.2	+36.5	+368
Baltimore Metropolitan Area	*16,360*	*15,336*	*422,500*	*1,225,746*	*100.0*	*100.0*	*100.0*	*100.0*	−6.3	+190
Baltimore	14,116	12,579	380,103	1,051,564	86.3	82.0	90.0	85.8	−10.9	+177
Balance of Area	2,244	2,757	42,397	174,182	13.7	18.0	10.0	14.2	+22.9	+311
Buffalo Metropolitan Area	*13,868*	*14,222*	*365,316*	*1,025,946*	*100.0*	*100.0*	*100.0*	*100.0*	+2.6	+181
Buffalo	8,459	8,313	250,311	662,987	61.0	58.5	68.5	64.6	−1.7	+165
Balance of Area	5,409	5,909	115,005	362,959	39.0	41.5	31.5	35.4	+9.2	+216
Milwaukee Metropolitan Area	*11,196*	*9,757*	*324,906*	*921,287*	*100.0*	*100.0*	*100.0*	*100.0*	−12.9	+184
Milwaukee	9,375	7,764	288,244	789,597	83.7	*79.6*	88.7	85.7	−17.2	+174
Balance of Area	1,821	1,993	36,662	131,690	16.3	20.4	11.3	14.3	+9.4	+259
Minneapolis-St. Paul Metropolitan Area	*12,577*	*10,161*	*474,745*	*1,257,233*	*100.0*	*100.0*	*100.0*	*100.0*	−19.2	+165
Minneapolis-St. Paul	10,613	8,261	437,082	1,127,213	84.4	81.3	92.1	89.7	−22.2	+158
Balance of Area	1,964	1,900	37,663	130,020	15.6	18.7	7.9	10.3	−3.3	+245
Kansas City Metropolitan Area	*9,690*	*8,944*	*296,556*	*974,377*	*100.0*	*100.0*	*100.0*	*100.0*	−7.7	+229
Kansas City, Missouri and Kansas	7,222	6,741	260,097	844,860	74.5	75.4	87.7	86.7	−6.7	+225
Balance of Area	2,468	2,203	36,459	129,517	25.5	24.6	12.3	13.3	−10.7	+255
Cincinnati Metropolitan Area	*11,151*	*10,090*	*319,486*	*875,903*	*100.0*	*100.0*	*100.0*	*100.0*	−9.5	+174
Cincinnati	7,006	6,357	230,446	615,558	62.8	63.0	72.1	70.3	−9.3	+167
Balance of Area	4,145	3,733	89,040	260,345	37.2	37.0	27.9	29.7	−9.9	+192
Houston Metropolitan Area	*6,413*	*7,919*	*213,998*	*811,198*	*100.0*	*100.0*	*100.0*	*100.0*	+23.5	+279
Houston	5,148	5,799	193,965	691,193	80.3	73.2	90.6	85.2	+12.6	+256

Cincinnati	7,006	6,357	230,446	615,558	62.8	63.0	72.1	70.3	−9.3	+167
Balance of Area	4,145	3,733	89,040	260,345	37.2	37.0	27.9	29.7	−9.9	+192
Houston Metropolitan Area	*6,413*	*7,919*	*213,998*	*811,198*	*100.0*	*100.0*	*100.0*	*100.0*	+23.5	+279
Houston	5,148	5,799	193,965	691,193	80.3	73.2	90.6	85.2	+12.6	+256
Balance of Area	1,265	2,120	20,033	120,005	19.7	26.8	9.4	14.8	+67.6	+499
Portland, Oregon, Metropolitan Area	*7,234*	*7,348*	*227,033*	*768,318*	*100.0*	*100.0*	*100.0*	*100.0*	+1.6	+238
Portland	4,800	4,618	183,551	572,128	66.4	62.8	80.8	74.5	−3.8	+212
Balance of Area	2,434	2,730	43,482	196,190	33.6	37.2	19.2	25.5	+12.2	+351
Seattle Metropolitan Area	*8,389*	*7,834*	*238,317*	*749,464*	*100.0*	*100.0*	*100.0*	*100.0*	−6.6	+214
Seattle	6,563	5,732	208,537	609,739	78.2	73.2	87.5	81.4	−12.7	+192
Balance of Area	1,826	2,102	29,780	139,725	21.8	26.8	12.5	18.6	+15.1	+369
Dallas Metropolitan Area	*5,217*	*5,928*	*188,536*	*708,545*	*100.0*	*100.0*	*100.0*	*100.0*	+13.6	+276
Dallas	4,294	4,660	172,904	625,397	82.3	78.6	91.7	88.3	+8.5	+262
Balance of Area	923	1,268	15,632	83,148	17.7	21.4	8.3	11.7	+37.4	+432
Atlanta Metropolitan Area	*5,954*	*5,748*	*203,543*	*661,026*	*100.0*	*100.0*	*100.0*	*100.0*	−3.5	+225
Atlanta	4,137	3,516	172,279	515,188	69.5	61.2	84.6	77.9	−15.0	+199
Balance of Area	1,817	2,232	31,264	145,838	30.5	38.8	15.4	22.1	+22.8	+366
Providence Metropolitan Area	*9,307*	*8,940*	*251,291*	*647,814*	*100.0*	*100.0*	*100.0*	*100.0*	−3.9	+158
Providence	4,010	3,823	131,847	325,027	43.1	42.8	52.5	50.2	−4.7	+146
Balance of Area	5,297	5,117	119,444	322,787	56.9	57.2	47.5	49.8	−3.4	+170
Indianapolis Metropolitan Area	*5,790*	*5,233*	*197,234*	*624,219*	*100.0*	*100.0*	*100.0*	*100.0*	−9.6	+216
Indianapolis	5,208	4,595	188,553	583,072	89.9	87.8	95.6	93.4	−11.8	+209
Balance of Area	582	638	8,681	41,147	10.1	12.2	4.4	6.6	+9.6	+374
Denver Metropolitan Area	*5,725*	*5,402*	*195,932*	*592,281*	*100.0*	*100.0*	*100.0*	*100.0*	−5.6	+202
Denver	4,706	4,206	177,963	508,039	82.2	77.9	90.8	85.8	−10.6	+186
Balance of Area	1,019	1,196	17,969	84,242	17.8	22.1	9.2	14.2	+17.4	+369
New Orleans Metropolitan Area	*7,468*	*7,646*	*167,027*	*546,504*	*100.0*	*100.0*	*100.0*	*100.0*	+2.4	+227
New Orleans	6,673	6,608	157,062	502,030	89.4	86.4	94.0	91.9	−1.0	+220
Balance of Area	795	1,038	9,965	44,474	10.6	13.6	6.0	8.1	+30.6	+346
Louisville Metropolitan Area	*5,639*	*5,676*	*152,668*	*515,949*	*100.0*	*100.0*	*100.0*	*100.0*	+0.6	+238
Louisville	4,143	4,036	131,004	410,199	73.5	71.1	85.8	79.5	−2.6	+213
Balance of Area	1,496	1,640	21,664	105,750	26.5	28.9	14.2	20.5	+9.6	+388
Columbus, Ohio, Metropolitan Area	*4,933*	*4,654*	*172,974*	*505,002*	*100.0*	*100.0*	*100.0*	*100.0*	−5.7	+192

Louisville Metropolitan Area	*5,639*	*5,676*	*152,668*	*515,949*	*100.0*	*100.0*	*100.0*	*100.0*	+0.6	+238
Louisville	4,143	4,036	131,004	410,199	73.5	71.1	85.8	79.5	−2.6	+213
Balance of Area	1,496	1,640	21,664	105,750	26.5	28.9	14.2	20.5	+9.6	+388
Columbus, Ohio, Metropolitan Area	*4,933*	*4,654*	*172,974*	*505,002*	*100.0*	*100.0*	*100.0*	*100.0*	−5.7	+192
Columbus	4,233	3,932	159,167	458,960	85.8	84.5	92.0	90.9	−7.1	+188
Balance of Area	700	722	13,807	46,042	14.2	15.5	8.0	9.1	+3.1	+234
Rochester Metropolitan Area	*5,900*	*5,449*	*190,675*	*489,295*	*100.0*	*100.0*	*100.0*	*100.0*	−7.6	+157
Rochester	4,856	4,265	169,967	408,441	82.3	78.3	89.1	83.5	−12.2	+140
Balance of Area	1,044	1,184	20,708	80,854	17.7	21.7	10.9	16.5	+13.4	+290
Memphis Metropolitan Area	*3,897*	*4,117*	*140,595*	*475,752*	*100.0*	*100.0*	*100.0*	*100.0*	+5.6	+238
Memphis	3,363	3,528	135,486	452,457	86.3	85.7	96.4	95.1	+4.9	+234
Balance of Area	534	589	5,109	23,295	13.7	14.3	3.6	4.9	+10.3	+356
Toledo Metropolitan Area	*4,212*	*4,178*	*144,008*	*445,273*	*100.0*	*100.0*	*100.0*	*100.0*	−0.8	+209
Toledo	3,549	3,400	131,629	395,870	84.3	81.4	91.4	88.9	−4.2	+201
Balance of Area	663	778	12,379	49,403	15.7	18.6	8.6	11.1	+17.3	+299
Birmingham Metropolitan Area	*3,899*	*5,152*	*123,953*	*439,163*	*100.0*	*100.0*	*100.0*	*100.0*	+32.1	+254
Birmingham	2,651	3,078	100,136	340,053	68.0	59.7	80.8	77.4	+16.1	+240
Balance of Area	1,248	2,074	23,817	99,110	32.0	40.3	19.2	22.6	+66.2	+316

[1] Since this analysis was made before the 1950 census of population was completed, the following cities with 1950 populations in excess of 250,000 were not included: Albany-Schenectady-Troy, San Diego, Akron, Fort Worth, San Antonio, Norfolk-Portsmouth. In addition, Providence, Rhode Island, would have been dropped because its 1950 population figure was less than 250,000. The San Antonio Metropolitan Area is excluded from this table because annexation of parts of Bexar County by the city of San Antonio since 1939 makes comparisons difficult.

[2] These figures were taken from the preliminary County reports of the 1948 Census of Business. The final figures show some change, but these changes are not of sufficient importance to destroy the usefulness of the preliminary figures for the purposes of this analysis.

literature on decentralization is couched in terms of the declining position of the central business district. Under these circumstances, it would be useful to have information about the relative position of the central business district within its own metropolitan area. But how does one go about determining this relative position of the central business district? Unfortunately, the Census of Business does not present this type of comparison. This information is collected, however, and is obtainable by census tracts through special arrangements with the Bureau of the Census.

At least two recent studies have been completed where such arrangements have been made, and evidence is presented indicating the relative position of the central business district in the entire metropolitan area. (2) These studies were conducted in Seattle, Washington, and Detroit, Michigan. In each instance it was necessary to delineate a central business district that conformed to the established census tracts. Conformity with the census tracts is necessary because a census tract is generally the smallest geographical area for which such census information will be released. (3)

In Seattle, the central business district accounted for 20.8 percent of all the retail stores in the metropolitan area in 1939 and 16.9 percent in 1948. This was a drop of 24 percent as compared with a drop of 13 percent in the central city and a gain of 15 percent in the balance of the area.[3] The sales volume in the central business district increased by 158 percent from 1939 to 1948 as compared with an increase of 192 percent in the central city and 369 percent in the balance of the area. The percentage of the metropolitan area sales volume done in the central business district declined from 35 percent to 28 percent. This is a decline of 18 percent compared to a decline of 7 percent in the central city and an increase of 47 percent in the balance of the area.

The central business district of Detroit accounted for 4.5 percent of all the retail stores in the metropolitan area in 1939, but only 3.9 percent in 1948. This drop of 17 percent compares with a decline of 9 percent for the central city and an increase of 19 per-

[3] The term "balance of the area" refers to the difference between the metropolitan area and the central city. The central business district is part of the central city, and is not the point of reference in determining statistics for the "balance of the area."

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cent for the balance of the area. The increase in retail business in the central business district was 145 percent while it increased 202 percent in the central city and 288 percent in the balance of the area. The share of the sales volume originating in the central business district declined from 19 percent in 1939 to 14 percent in 1948. This decline of 26 percent compares with the drop of 10 percent in the central city and a gain of 9 percent in the balance of the area.

These data leave little doubt as to the reality of decentralization of trade in these 32 areas between 1939 and 1948. It has occurred. The same amount of decentralization has not been witnessed in all cities; nevertheless, it has gained impetus in all of them.

Retail Revolution 'Painless'

From an economic point of view, this revolution in retailing has been "painless" in at least two respects. First, those retailers whose relative position—sales volume-wise—has declined, have enjoyed absolute gains in sales throughout this period; such gains are conducive to profit-making. Second, many retailing establishments present in the 1939 census count, but absent in the 1948 count, went out of business during the war years when other opportunities for employment outside of retailing—often better—were presented to the operators of such establishments. Historically, changes of such magnitude in our marketing system have been associated with violent changes in economic conditions that require painful economic adjustments.

During the last five years, from 1949 through 1953, even though the statistical evidence in the form of a census is not available for support, the trend toward decentralization continues. And insofar as something can be new, there is something new—the "controlled" shopping center. The controlled shopping center "is initiated by a private organization and is so planned that all of its development may be regulated for the benefit of both the community and the center itself." (4) These centers vary in size from the small community center, in which several of the consumer's wants are made available, to the large integrated regional centers built around one or more department stores where very few wants cannot be fulfilled.

The distinguishing feature of the shopping center is the plan-

ing that goes into it. This is in contrast to the older shopping districts where stores just seemed to accumulate. Several of these shopping centers came into existence prior to World War II, but the significant growth has taken place in the last five years.

How many such centers have been established and how much business is being done in these centers is not now known. *Fortune* magazine points out that more than 300 branches of department and specialty stores were opened since about 1948. (5) In all probability many of these are part of shopping centers now in operation. When those under construction, or in the planning stage and scheduled for completion in 1954 or 1955, are added to those in operation, the total becomes 483. (6) So new are most of these shopping centers that by the end of 1954, half of them will be less than two years old.

Birth can be given to a retail store by its owners, but only the customer can keep it alive. What fundamental changes have taken place in the United States that enable new retail stores to come to life and prosper where heretofore no stores existed, and at the same time permit stores that have been in existence for some time to continue to prosper? The basic changes of major significance making this possible have occurred in the size of our population, where that population lives, and the standard of living which these people enjoy.

From 1940 to 1950 the increase in population in the United States was in excess of 19 million. Even since 1950 another 9.3 million have been added, giving us close to a 30 million increase since 1940. One day during 1953 the total population passed the 160 million mark. What is of greater importance from a marketing point of view, the rate of increase for household units has been greater than that for the population; and the household unit is the consuming unit.[4]

Since 1945 there have been about 14 million marriages in the United States. A smaller percentage of our women under fifty years of age are unmarried than was true before World War II. In addition, women marry at a younger age, have their first child at a younger age, and are producing more second, third, fourth, and fifth children. The large number of two-people families in the older

[4] All persons who live in the same dwelling unit are counted as a household unit.

age group has prevented the average size of American families from increasing, despite the large additions to the population.

This population is not distributed geographically as it was in 1940. The population increase from 1940 to 1950 was 14.3 percent. The increase was 21.2 percent in the metropolitan areas in 1940 and less than 6 percent in the non-metropolitan areas. In the 32 metropolitan areas under consideration here, the population increase in the central city was about 10 percent which indicates that the greater increase took place in the balance of the area. *Fortune* magazine states that population in suburban communities has increased by 43 percent since 1947, with approximately 1,200,000 moving into the suburbs in each of the last three years beginning in 1950. (7) The mobility of the American people is attested to in the following statement:

Nine out of ten persons one-year old and over in this country in April, 1952, had moved at least once in their lifetime. About one-fourth had moved since January, 1951, three-fifths since 1946, three-fourths since 1941 and four-fifths since 1935. Most of the persons who have always lived in one house are young children. Only 2 percent of the adult population had always lived in the same house.

Approximately 30 million people move in a year. Of these 20 million move to another house in the same county; 5 million move to another county in the same state; and 5 million move to another state. (8)

For the last several years Americans have possessed greater economic potency than ever before in our history. Not only has the total income soared, but the distribution of it has changed in such a manner that those who were in the lowest income groups have experienced the biggest gains. Over 26 million consumer spending units moved up to the level above $3,000, with an increase in this group from 5,703,000 or 14.5 percent in 1941 to 31,860,000 or 59 percent in 1953. These shifts resulted in an increase of 72 percent in real purchasing power, and even with our large population gains, there was still a 39 percent per capita increase in real purchasing power.

According to a recent article in *Fortune* magazine, "the most important change of the last few years, by all odds, is the rise of

the great mass into a new moneyed middle class—a rapidly growing market that seems bound, sooner or later, to become *the* American market." (9)

Per Capita Purchasing Increased

From a retailing point of view, changes as basic as these could mean only one thing: more retailing capacity. Such capacity, as has always been the case, would have to be located carefully if it were to be patronized sufficiently. Where large construction costs were involved—and this was true in so many cases—there was even greater incentive to careful planning of location. As a result, the great bulk of the new retailing capacity followed the population and purchasing power; and these were moving toward the periphery of the metropolitan areas. The historical pattern of taking the merchandise and services of retailing to the customer was again being followed.

Mistakes have been made. In some locations, this new capacity was apparently based primarily on the realized decentralization of the population and purchasing power rather than on the realized, plus the anticipated, decentralization of population and purchasing power. Expansion activity under way in many of the very new shopping centers is evidence that the mistakes made were mostly on the side of underestimating rather than on the side of overestimating the support the consumers would give to such retailing establishments. Only the future will tell whether development of stores in the peripheral area will be overdone; to date, however, consumers have provided the patronage that has been needed.

With this continued movement of the population to decentralized areas, what is the future of the central business district? The statistics presented indicate what has happened; namely, that a smaller percentage of the total sales of the metropolitan area is transacted in the central business district. Will this trend continue? Obviously the answer to this must be speculative, but the question is of sufficient importance to encourage exploration from all sides.

The downtown shopping area is not likely to prosper unless substantial sales can be obtained from residents of the decentralized areas. Since there is little or no incentive for going any great distance to buy convenience goods, such sales made by downtown

retailers would be in the shopping goods line. Under what circumstances would the people of a decentralized area—when shopping goods are available near their home—be likely to journey to the central business district to shop? Ordinarily they would be likely to do this only if one or the necessary combination of the following conditions prevailed:

1. If the merchandise selection were better.
2. If the price or arrangements for getting the merchandise were more favorable.
3. If shopping downtown represented an enjoyable experience.
4. If downtown shopping could be combined with another activity which could only be done downtown.
5. If habit, tradition, or loyalty were involved.
6. If it were easy to get into and out of downtown even though several miles of travel were involved.

A detailed analysis of these first five items is beyond the scope of this paper; however, it should be pointed out that these are the items that could well be exploited as advantages of the downtown area or of stores in the downtown area. But these could be exploited only if condition No. 6 became a reality. While it may be true that traffic congestion, inadequate parking, and the use of public transportation are not looked upon by everyone as problems, those who regard them as such seem to represent an ever-increasing number.

This does not mean that the only problem facing the downtown area is getting enough customers in and out of the shopping area, but it does mean that as long as this problem remains as serious—from the shopper's viewpoint—as it has been in recent years, the chances of downtown making a come-back are lessened.

This is more than just a problem of inadequate parking space and congested streets, because all people do not use personal cars for shopping, particularly downtown shopping. The incidence of family automobile ownership in the United States is about 70 percent. Some of these automobiles are not available for downtown shopping. In other instances the shopper is not a driver—or at least not a central business district driver. For those who do not arrive in the downtown area by personal car, there is dependence on the public transportation system.

Public transportation systems in cities throughout the country have been facing problems. In so many cities their revenue is declining because of the drop in the number of passengers. This, together with the rising costs, compels them to ask for fare increases at a time when many observers are of the opinion that fares are already too high, if the use of the transportation system for shopping is to be encouraged. When public transportation fares are increased, downtown usually suffers.

As in most ventures where there are different people with an interest, each one has not accepted his proper share of the responsibility, with the result that the over-all attempt at "merchandising downtown" has not succeeded. So big is the problem of creating customer traffic in downtown that everyone who has an interest must become a participant. Before this can be started, it is necessary to make it clear who the interested parties are.

First, there is the municipality that will face reduced tax income if the central business does not prosper. Second, there are the newspapers, and other media such as radio and television that depend on advertising revenue from those stores which expect to draw customers from the entire metropolitan area. Third, there are the operators of the public transportation system. Shoppers who use the transportation system are especially attractive customers since much of their riding is at off-peak hours. Fourth, there is the interest of the property owner, and this is particularly true if the rentals are related to sales volume. Fifth, the many service businesses, such as banks, investment brokers, light and power companies, etc., whose welfare is closely tied in with the success of retailers in the area, are vitally concerned.

And, of course, there is the retailer whose stake in this problem is obvious. All these groups have an interest in the problem. They must be recognized and must accept this responsibility.

What has to be initiated by this group is not mere patchwork; it is rehabilitation. This is work that calls for the services of those who are competent to face many specialized problems: The transportation engineer when expressways, highways, parking and public transportation are involved; the market analyst to estimate the market potential; the architect and designer to adapt the physical en-

vironment of the store to the customer. These are examples that could be extended considerably. Behind this talent, of course, there must be aggressive action by all merchants in the area in selling both downtown and their own services.

Summary

The proportion of retail sales transacted in the central cities of the largest metropolitan areas in the United States declined from 1939 to 1948. This undoubtedly applies to the central business districts as well, even though only two supporting examples were presented. This trend has continued since 1948 and can be seen in the large number of new decentralized shopping centers that have been established and are operating successfully throughout the country. Since retailers must serve customers effectively if they are to succeed, it is to be expected that the population and purchasing power will be followed to decentralized areas.

The movement of trade to outlying areas raises the question: What will happen to the downtown area? The answer to this is dependent to a large extent on the ability to create customer traffic downtown. This calls for improvements in the public transportation system and improvements in parking facilities for privately owned cars. In order to do this effectively, the people who have an interest in downtown must recognize and accept their responsibility. After this has been done, a positive program for the rehabilitation of downtown must be started. In carrying out this activity, the representatives of the interested parties will have to enlist the services of many specialists.

NOTES

1. *Census of Business: 1948, Retail Trade*—Washington, D. C., Vol. III.

2. William J. Watkins, "Relationship Between Downtown Automobile-Parking Conditions and Retail-Business Decentralization," *Highway Research Board,* Washington, D. C., 1953, and Louis C. Wagner, "Economic Relationships of Parking to Business in Seattle Metropolitan Area," *Highway Research Board,* Washington, D. C., 1953.

3. The detail, by kind of business, shown for any area also is affected by the provisions of Census law designed to prevent disclosure of confidential

information. Wherever disclosure of figures for an individual store might otherwise result, all data for the kind of business, except "Number of establishments," were suppressed. To prevent derivation of the suppressed figures by subtraction, it always was necessary that data for another kind of business in the same table also be withheld.

4. John E. Mertes, "The Shopping Center—A New Trend in Retailing," *The Journal of Marketing*, Vol. III, (January, 1949), p. 375.

5. "The Changing American Market: IV, The Lush New Suburban Market," *Fortune*, November 1953, p. 232.

6. "Shopping Center Boom Grows," *Women's Wear Daily*, December 28, 1953, sec. 2, p. 32.

7. "The Changing American Market: IV, The Lush New Suburban Market," *Fortune*, November 1953, p. 232.

8. Vergil D. Reed, "Cupid, The Stork, The Grim Reaper, Change And Your Market," *Twenty-fifth Annual Boston Conference on Distribution*, 1953, p. 56.

9. Gilbert Burck and Sanford Parker, "The Changing American Market," *Fortune*, August 1953, p. 99.

The Garden State Parkway

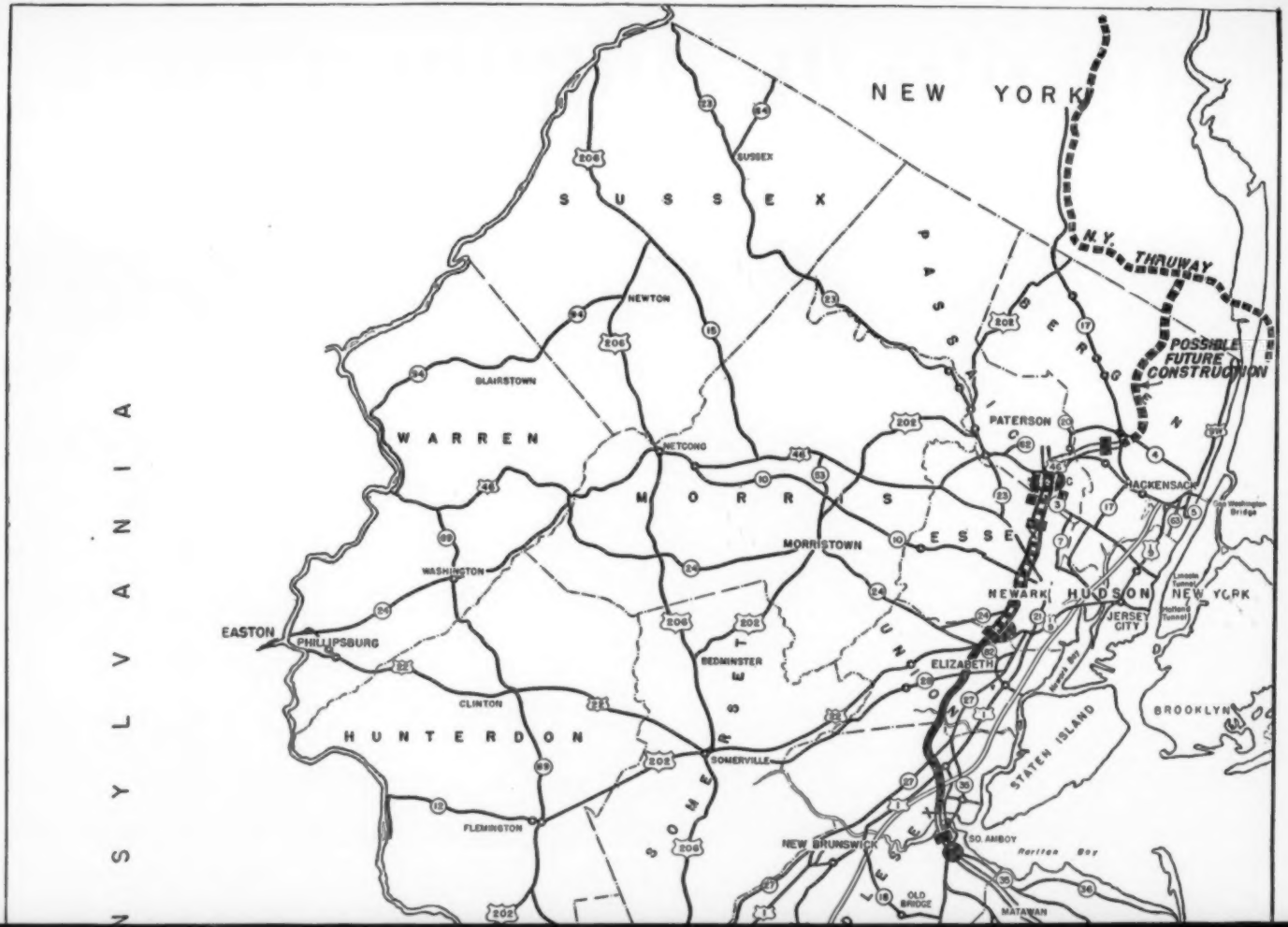
W. CARMAN DAVIS

Mr. Davis, a graduate civil engineer, is director of public information for the New Jersey State Highway Department. After three years with the American Bridge Company, he entered the employ of New Jersey's Highway Department in 1923 as a bridge inspector. During subsequent years he was a draftsman, designer of bridges, engineer of special assignments, executive assistant to the State Highway Commissioner, and later director of public information with the Highway Authority. During thirty years with the highway department, he has come in contact with all phases of highway construction as well as with economic and traffic problems pertaining to highways.

THE Garden State Parkway, now being built along New Jersey's eastern border, represents the state's second venture into multi-million dollar toll road construction to provide early relief for its overcrowded highways. The 118-mile New Jersey Turnpike, opened to the public in late 1950 and early 1951 and now carrying traffic loads predicted for 1970, was the first such road to be built in the state.

A glance at the map of eastern United States will reveal why New Jersey has been for many years a vortex of traffic. Situated at the hub of the Atlantic seaboard midway between Boston and Washington, the state forms a corridor through which millions of vehicles are channeled from New York and New England to the south and west, as well as the vast intercity traffic between New York City and Philadelphia.

As if this were not enough to produce unparalleled state-wide traffic, New Jersey is second to Rhode Island in density of population, sixth in industry, forty-fifth in size among the states, eighth in motor vehicle registration, and annually attracts twenty-five million visitors to its famous chain of seashore resorts. The result of these factors is an average daily traffic volume of 9,700 vehicles per mile on the state system of highways. Some interchanges record daily traffic volumes of 100,000 vehicles.


NEW YORK
SUSSEX
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MORRIS
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BERGEN
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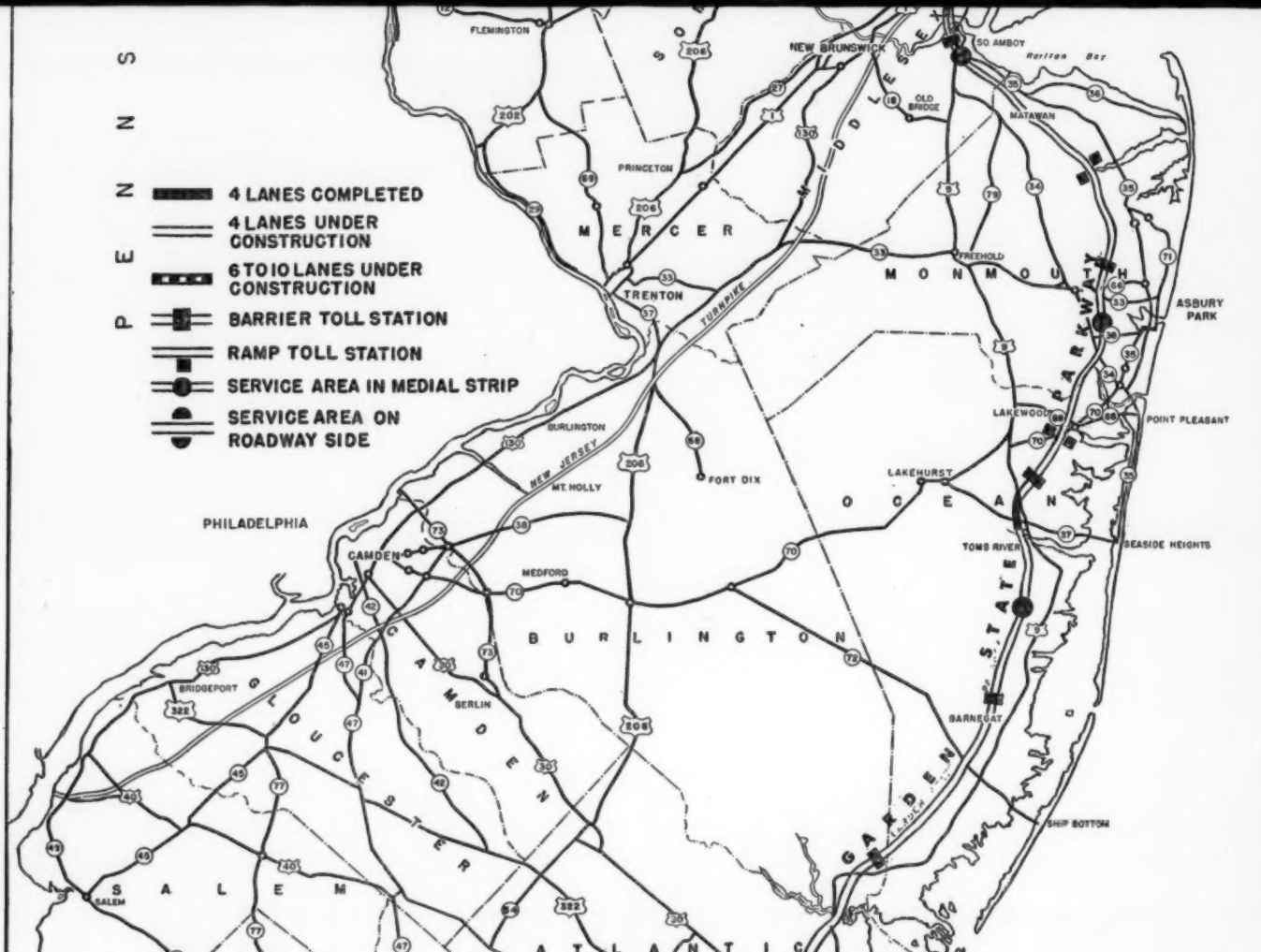
N.Y. THRUWAY
POSSIBLE FUTURE CONSTRUCTION
NEWTON
BLAIRSTOWN
NETCONG
WASHINGTON
MORRISTOWN
EASTON
PHILLIPSBURG
BEDMINSTER
CLINTON
FLEMINGTON
SOMERVILLE
NEW BRUNSWICK
PATERSON
HACKENSACK
NEWARK
HUDSON
JERSEY CITY
NEW YORK
ELIZABETH
STATEN ISLAND
BROOKLYN
SO. AMBOY
Raritan Bay
OLD BRIDGE
MATAWAN
PENNSYLVANIA


4 LANES COMPLETED
4 LANES UNDER CONSTRUCTION
6 TO 10 LANES UNDER CONSTRUCTION
BARRIER TOLL STATION
RAMP TOLL STATION
SERVICE AREA IN MEDIAL STRIP
SERVICE AREA ON ROADWAY SIDE
PENNSYLVANIA
FLEMINGTON
NEW BRUNSWICK
SO. AMBOY
Raritan Bay
OLD BRIDGE
MATAWAN
PRINCETON
MERCER
MIDDLESEX
TRENTON
TURNPIKE
FREEHOLD
MONMOUTH
ASBURY PARK
PARKWAY
LAKEWOOD
POINT PLEASANT
BURLINGTON
NEW JERSEY
FORT DIX
LAKEHURST
OCEAN
PHILADELPHIA
CAMDEN
MT. HOLLY
TOMS RIVER
SEASIDE HEIGHTS
MEDFORD
BURLINGTON
STATE
BRIDGEPORT
GLOUCESTER
BERLIN
CAMDEN
BARNEGAT
GARDEN
SHIP BOTTOM
SALEM
ATLANTIC

The Garden State Parkway from Paterson to Cape May, N. J.

The Turnpike now traverses the New Jersey "corridor," extending diagonally across the state from northeast to southwest, and is relieving other highways to the extent of 60,000 vehicles a day. Constructed almost entirely through open country, with only fifteen interchange points along its 118-mile length, traffic on this road is approximately 70 percent interstate.

By way of comparison, the Garden State Parkway will penetrate the very heart of New Jersey's vast metropolitan area where it will form the first continuous north-south route and extend south to serve the popular coastal area. Along its length, more than 200 entrance and exit ramps will serve directly the area through which it passes.

As legislated, the Garden State Parkway will begin at Paramus and Paterson in the north and extend 165 miles to Cape May at the southern end of the state. It is being constructed at an estimated cost of $285 million.

How the Parkway Began

The Garden State Parkway was originally conceived as a part of the state highway system to be built out of annual highway appropriations. Following passage of New Jersey's Parkway and Freeway Act, ground first was broken in November, 1946, in Union County. By the spring of 1950 a ten-mile section of the road, from Cranford to Woodbridge Township just north of the Raritan River, was opened to traffic. Subsequently, two shorter stretches, both less than four miles in length, were completed. One of these sections by-passes Toms River in Ocean County. The other skirts Cape May Court House in Cape May County.

As it became evident that construction of the Garden State Parkway from annual highway appropriations would defer its completion for as long as forty years, other methods of financing were investigated. Traffic and revenue studies showed the feasibility of making the Parkway a toll road, and legislation creating the New Jersey Highway Authority was enacted in April of 1952. The Authority was empowered to build, maintain, and administer the Parkway and finance the project with state-backed bonds. This state

guaranty was subject to a referendum at the November, 1952 election. When the proposal received overwhelming voter endorsement, construction on a large scale was started immediately.

Governor Driscoll named as Authority members: Ransford J. Abbott, the state highway commissioner, chairman; Bayard L. England, president of the Atlantic City Electric Company; and Orrie de Nooyer, vice president of Julius Forstmann and Son.

Prior to entering into permanent financing, the Authority operated on $28 million in temporary loans from one hundred and forty-five banks, including one hundred and thirty-eight New Jersey institutions. These loans were paid back from the sale of $150 million Garden State Parkway Series A bonds awarded on July 8 to a group of three hundred financial institutions, including some of the nation's largest banks. The bonds, dated July 1, 1953, mature serially from 1960 to 1988—and after taking into account the discount of $2,425,500, the net interest cost to the Authority is 2.9997 percent.

The Authority's $135 million Series B bonds, dated January 1, 1954, were awarded to a nation-wide group of more than three hundred institutions on November 18. These bonds mature concurrently with the Series A bonds. Their net interest cost of 2.7652 percent reflects improved market conditions.

The state guaranty of Parkway bonds resulted in saving an estimated 1 percent in financing the $285 million bonds of the thirty-five-year period.

The first contracts on the Parkway were awarded in August, 1952, and in the intervening sixteen months $140 million in construction contracts have been placed in the ten counties through which the road will pass. At present a total of one hundred and thirty-five miles of the Parkway is under construction.

Design Characteristics

The Garden State Parkway will be a dual-roadway, limited-access highway built upon an exclusive right-of-way. Although access is denied, the Parkway will not be a "barrier" road in the commonly

accepted meaning of the term. In keeping with the basic concept of the project as a road for New Jersey motorists, the Parkway will have a total of one hundred points of entrance and one hundred points of exit in order to best serve the fifty-two communities through which it passes.

Right-of-way width varies according to the characteristics of the areas traversed. In some urban sections of the state, right-of-way narrows in spots to 200 feet, while in rural locations the over-all width is as much as 1000 feet with a median strip up to 600 feet wide. Dual roadway design will be used throughout the entire length of the project.

The completed Parkway will have no traffic lights or intersections at grade to impede or endanger travel. All crossroads will be overpassed or underpassed throughout its length.

Horizontal curves will be superelevated to accommodate speeds of 70 MPH, although present plans call for the enforcement of speeds of 50 MPH between Clifton and Irvington, and 55 MPH in other locations in the interest of safety.

Steep grades and sharp vertical curves will be completely eliminated to assure economical and safe driving. Maximum grades of 3 percent in general will prevail.

From Irvington to Clifton each roadway will consist of three twelve-foot traffic lanes in each direction. North and south of this section two twelve-foot lanes will be provided. In all cases both roadways will be bordered by a ten-foot hard-surfaced shoulder on the outer side and a three-foot shoulder adjacent to the center mall.

In the heavily congested section of Essex County, outer roadways will be constructed at the adjacent street level for local traffic, providing a total of ten lanes in an area where it is estimated the Parkway will carry 80,000 to 90,000 cars a day.

Between Asbury Park and Route U. S. 9, north of the Raritan River, provisions are being made for a third roadway within the wide median strip. This roadway will be reversible in the direction of the heaviest traffic flow and will be constructed when increased traffic volumes indicate the need. Foundations of bridges for this center road are being laid at this time as an economy measure.

The Highway Authority believes that the Garden State Parkway will offer unparalleled opportunities for safe travel through its design and sane speed limits. Every known element which might possibly contribute to this safety is planned for the eventual roadway.

Substantial Progress in 1953

The year 1953 was one of accelerated activity on the Garden State Parkway. Of the 282 bridges over twenty feet long needed to carry the route over and under highways and railroads and across streams, 177 were begun in 1953; 105 were made ready for steel, and thirty-two were decked. Substantial progress on the 4400-foot Raritan River span advanced its target date for completion from October, 1954 to July, 1954.

Paving operations already have begun at several points along the Parkway and the first toll section—Mill Road to Route 22 in Union County—was opened on January 12, 1954. At present, one hundred and three contracts are in effect along the route out of an expected total of one hundred and fifty-three.

In keeping with the urgent need for the completed Parkway, the Highway Authority established target dates which will require the utmost effort to meet. The largest single unit expected to open at one time will extend from Irvington in Essex County to Absecon (Atlantic City)—a distance of one hundred and seven miles.

This section is time-tabled to open by June, 1954, with the exception of the Raritan River Bridge which will be finished about a month later. Prior to its completion, Parkway traffic will be routed over the adjacent Edison Bridge. The thirty-six-mile section from Atlantic City to Cape May is target-dated for opening by July with earlier completion probable.

On the northern portion of the Parkway where construction difficulties are multiplied by the urban nature of the area, the road is scheduled for traffic by the end of this year. To serve the traveling public to the fullest degree, however, the Authority decided that short sections of the Parkway will be opened as completed.

Advantages of the Parkway

With a 50 MPH speed limit from Paterson to Union and a 55-mile limit on other sections of the Parkway, time savings as indicated below have been estimated:

From Paterson	*Hours via Existing Routes*	*Hours via Parkway*
to Asbury Park	2.2	1.3
to Atlantic City	3.7	2.6
to Cape May	4.5	3.1

Statistics compiled by independent researchers on completed Parkway sections between Union Township and Woodbridge Township in comparison with the most direct (and somewhat shorter) alternate highways disclose the following: Parkway trips averaged 17.25 minutes and speeds averaged 44.6 miles an hour. On the alternate route the average elapsed time was 29.5 minutes and the average speed 29.5 miles an hour.

These tests also revealed a marked fuel savings to cars using the Parkway where an average of 16.2 miles a gallon was obtained. On the alternate highways, where stops and starts were frequent, mileage dropped to 9.55 per gallon. While no estimate of tire and brake or oil savings on the Parkway was made, it is apparent that these items, plus a 300 percent lesser accident frequency on the Parkway, add substantially to the over-all savings to be realized by motorists. Related to the Newark to Asbury Park trip, the savings in gasoline alone will amount to fifty-four cents as compared to a toll charge of seventy-five cents. It is entirely possible that other savings may offset the remaining twenty-one cents of the toll.

Time and operation savings will be materially increased during the summer vacation season. At such times existing coastal highways become clogged with bumper-to-bumper traffic and it has taken as long as five hours to travel from Asbury Park to Newark on a summer Sunday night.

In addition to safe and economical travel, the Parkway also will provide pleasant motoring with its wide traffic lanes, expansive landscaped median strip and well-kept roadsides. By affording easy

and direct access, the Parkway will add almost unbelievable economic benefits to the entire seashore area and communities in the northern counties of the state through which it passes. Already evidences of this impending boom are seen in increased real estate buying and home building along the Parkway. Traffic volumes of 30,000 vehicles a day are now using the completed section in Middlesex and Union counties to the relief of other roads by affording more room for local traffic.

Traffic and Revenue

Traffic and revenue studies disclose that the Parkway will be entirely self-supporting without the need for state revenue as pledged. It is estimated that 52, 833,000 vehicles will use the road in 1955, the first full year of operation. This is more than six times the traffic predicted for the Turnpike. The resultant revenue is estimated at $12,003,000. Some twenty-two million vehicles out of the estimated total will use the Parkway without paying toll. This results from three factors:

1. A large section of the Parkway in Essex County is designated as toll-free under the Parkway Act.

2. No toll will be charged on the sections constructed by the state highway department.

3. The more than 200 entrance and exit points along the route will provide for free travel between toll wickets for many vehicles.

Estimates place the increase in toll-paying traffic on the Parkway as follows:

1960	39,500,000	$15,508,000
1965	48,100,000	18,878,000
1970	56,600,000	22,248,000
1975	65,300,000	25,618,000
1980	71,300,000	27,980,000
1985	75,600,000	29,670,000

No estimates of the growth of free travel have been made.

Tolls on the Parkway will total $2 for the one hundred and sixty-five miles, averaging approximately one and one-quarter cents a mile. There will be eight across-the-road toll wickets between

Paterson and Cape May where passenger cars will pay twenty-five cents. In addition to the barrier stations on the main roadways, ramp stations are included at six locations, with passenger car tolls of ten cents at five of these points and twenty-five cents at one location. Typical passenger car toll rates for important movements include:

Typical Trips	*Total Toll*
Paterson to:	
Irvington	$ .25
Asbury Park	$1.00
Atlantic City	$1.75
Essex County points to:	
Asbury Park	$ .75
Atlantic City	$1.50
Cape May	$1.75

Buses will pay a toll of $1 at the Belleville and Union Stations and fifty cents at other stations on the main roadway. At the ramp stations bus toll will be either twenty-five or fifty cents.

Below Monmouth County existing legislation will permit trucks to use the Parkway south to Cape May. Truck tolls will vary from thirty-five to fifty cents according to size.

Parkway engineers believe that the across-the-road type of toll gate has many advantages over the off-the-road collection booths. They list these advantages as follows:

1. By requiring drivers to make occasional stops, many instances of so-called driving "hypnosis" experienced on uninterrupted super-highway travel will be avoided with consequent reduction of accidents.

2. The stop will afford drivers an opportunity to receive directions on where to leave the Parkway to reach their destinations.

3. It also will be possible to warn motorists of driving conditions on sections ahead in cases of fog, snow, or ice.

4. The across-the-road gates require far less land area and result in taking fewer ratables within communities.

5. The single coin collection—twenty-five cents—makes possible rapid handling of tolls with consequent reduced time-loss to motorists.

Toll collection plans and equipment are geared to handle $30 million revenue a year—the volume predicted for 1985.

Service Facilities

Restaurant and gasoline service stations will be strategically located at eight points along the Parkway. Three of these locations are north of the Raritan River, the balance spaced along the coast line.

These stations will be placed off the road within a special area and serve only one-direction traffic. South of the Raritan all facilities will be placed within the wide center island to serve traffic in both directions. All buildings will be of New Jersey colonial design and the restaurants and gasoline stations will be contiguous. These centers are being constructed by the Highway Authority and will be leased for operation. Provisions of the leases will require both a percentage of the gross receipts and a minimum guaranty to the Authority. Proposals are now being studied from nine restaurant firms and ten oil companies.

Landscaping Will Use Native Flora

The Garden State Parkway will be an outstanding example of the complete road, incorporating function, safety and aesthetic qualities. Landscaping materials will be confined largely to native flora placed in natural settings to blend with the beauty of the countryside. Formal landscaping as such will not be employed.

Flowering shrubs will be chosen which will extend the period of bloom over many months. Ground covering plants will be planted on slopes as a protection against erosion, and bridge wing walls and abutments will serve as back drops for group plantings.

In southern New Jersey where the Parkway traverses pine forests, landscaping will be confined to thinning out underbrush, allowing the trees to remain within the center island. Some 5,000 trees and 30,000 shrubs lying within the roadway areas are being salvaged for use elsewhere.

At locations where restricted right-of-way results in a narrow

New Jersey colonial architecture will feature the design of Parkway restaurants which will be spaced at eight locations along the route.

Wide median strip where large trees serve to shield drivers from oncoming headlights. Large trees were preserved when road was built.

A rendering of the Parkway's Raritan River bridge (foreground) showing the future third roadway which will be reversible in the direction of the heaviest traffic flow. The new structure parallels the Thomas A. Edison Memorial Bridge on U.S. 9.

A view of the completed section of the Parkway in Cranford, Union County. This is part of the toll-free length built by the State Highway Department.

median strip, wire fencing will be erected within the median strip to serve as a trellis for honeysuckle to shield against headlight glare.

The policy of the Authority will be to create a park the length of the state through which the Parkway will run—a one hundred and sixty-five-mile park traversing the ten eastern counties.

Link in Toll Road Network

It is natural that early planning envisions a connection between the Garden State Parkway and the great New York Thurway within the next few years. Such a move would relieve existing state highways and open new areas of development. At the southern terminus of the road, existing legislation provides for creating a ferry connection between Cape May and Lewes, Delaware. These two extensions, plus the present connection with the New Jersey Turnpike at Woodbridge, will make the Parkway a key link in the vast network of toll roads now completed or under construction through the Middle and New England states and extending westward to Chicago.

The proposed ferry across Delaware Bay will enable the Parkway to become the "missing link" in the coastal highway system extending to Key West. As such it will carry its share of the ever-increasing north-south vacation travel which reaches its peak during the winter months. But of even greater importance from an economic standpoint, the New Jersey coastline will once again become a magnet attracting additional thousands of visitors from the Baltimore-Washington area.

Looking to the future, the planners and builders of the Garden State Parkway believe that no highway development ever held such promise for the continued development of the state's economy, or the well-being of its five million residents.

NEW JERSEY HIGHWAY AUTHORITY

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Bayard L. England ..... *Vice-Chairman and Treasurer*
Orrie de Nooyer ..... *Secretary*

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Assistant Chief Engineer ..... Carl J. Teegen
Construction Engineer ..... C. E. Vanderhoof
Construction Engineer .... Harry A. Hartmann
Engineer of Parkway Design
Oliver A. Deakin
Drainage Engineer
Charles A. Van Antwerpen
Soils Engineer ..... Edward A. Henderson
Dist. Engineer, Sec. Nos. 1 & 2
Raymond H. Callahan
Dist. Engineer, Sec. Nos. 2 & 3
Robert R. Rice
Dist. Engineer, Sec. No. 7
Edward T. McNierney
Dist. Engineer, Sec. Nos. 8 & 10-n
Ralph Stelljes
Dist. Engineer, Sec. Nos. 10-s & 11 & 13
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Bond Counsel .... Hawkins, Delafield & Wood
Accountants ..... Puder & Puder
General Engineering Consultants
Parsons, Brinckerhoff, Hall & Macdonald
Consulting Traffic Engineers
Coverdale & Colpitts
Consulting Parkway Engineers
Clarke & Rapuano
Special Consultant ..... Col. F. F. Frech
Consulting Bridge Engineer
Morris Goodkind
Consulting Architect ..... Aymar Embury
Special Consultants
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CONSULTING ENGINEERS

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Edwards, Kelcey & Beck, Lincroft, N. J.
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Grassman & Kreh, 433 N. Broad St., Hillside, N. J.
J. E. Greiner Company, 15 Mechanic St., Cape May, N. J.
Hardesty & Hanover, New York, N. Y.
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Dr. B. B. Steinman, New York, N. Y.

The Traffic Point System as Used in the District of Columbia

GEORGE E. KENEIPP

Mr. Keneipp has been for eight years Director of Vehicles and Traffic for the District of Columbia, one of the largest departments of District government. In 1927 he joined the staff of the District division of the American Automobile Association as editor of the District edition of the American Motorist, later becoming manager of the D. C. division. From 1934 to 1946 he was affiliated with the Keystone Automobile Club as manager of the Washington office, and subsequently as manager of the southern division which combined the District of Columbia and Maryland. Mr. Keneipp in 1949 was appointed chairman of the committee on engineering and vehicle inspection of the American Association of Motor Vehicle Administrators in recognition of his work in this field. Last year he was elected president of the Eastern Conference of Motor Vehicle Administrators. On the Washington Board of Trade, Mr. Keneipp served two terms as member of the board of directors, eleven years as chairman of the Public Schools Committee, and one year as chairman of the Insurance Committee. He is also past president of the Washington Executives' Association.

FINDING the habitual traffic violator and the accident-prone driver is now an important responsibility of any department of motor vehicles. While major offenders generally are caught and dealt with according to the law, often nothing much is done to check the habitual so-called "minor" transgressor. This is the driver who time and again either carelessly or willfully violates traffic rules and regulations, in most cases being fortunate enough not to cause injury or property damage.

Some may consider these wayward motorists more of a nuisance than a hazard. Yet there is no doubt that, potentially and collectively, they are dangerous—a menace to themselves and to others on the road. When caught, they are usually fined and a record of their violation may or may not be made. They are then free to repeat their anti-social behavior until eventually they get into real trouble and lose their driver's permit.

Yet all the time, their growing record of "petty" offenses might have served as a portent of things to come, as a warning of the serious traffic accident toward which they were inevitably rolling.

On April 1, 1953, the District of Columbia put into operation a new system of keeping close check on both major violators and those whose motoring manners leave something to be desired. Since that date, the accumulation of points for moving traffic violations has determined the suspension or revocation of the operator's permit or the privilege of operating in the District of Columbia. Significantly, the bureau in the Department of Vehicles and Traffic assigned the task of dealing with the problem driver is named the Driver Improvement Section.

Point Scoring for Problem Drivers

Under the point system, the Department of Vehicles and Traffic keeps records of each driver's traffic violations and accidents. These records are based on reports of traffic violations which the police forward to the department. To protect all users of District streets, the department is required to suspend and revoke the operator's permit and privilege of persons with bad traffic records.

The operator's permit is suspended when the driver has a certain number of traffic violations. These violations are scored in points as follows:

Driving under the influence of intoxicating liquor or narcotic drugs	12 points
Leaving after colliding:	
With personal injury	12 points
Loaning or altering a permit	12 points
Negligent homicide, manslaughter, or assault by automobile	12 points
Obtaining or attempting to obtain a permit by misrepresentation	12 points
Operating after suspension or revocation	12 points
Reckless driving:	
With personal injury	12 points
Violation leading to jail sentence	12 points
Speeding more than 40 mph over legal speed	8 points

Violations contributing to accidents with collateral forfeiture or fine amounting to:	
$75 or over	7 points
$50 to $74	6 points
Failure to report accident	5 points
Leaving after colliding:	
With no personal injury	5 points
Reckless driving:	
With no personal injury	5 points
Violations contributing to accidents with collateral forfeiture or fine amounting to:	
$25 to $49 inclusive	5 points
Speeding more than 20 mph over legal speed	4 points
Violations contributing to accidents with collateral forfeiture or fine amounting to:	
Under $25	4 points
Speeding 10 to 20 mph over legal speed, or unreasonable speed	3 points
Passing red light or stop sign	2 points
Any moving violation not listed above and not contributing to an accident	1 point
For convictions and pleas of guilty certified to the District by other jurisdictions, points comparable to the District schedule are assigned at the discretion of the director.	

As each item is added to a driver's record in the master file of the department's Driver Improvement Section, the clerk scores the record for the previous three years. When this score totals three or more points the entire record is taken from the file and reviewed.

Three points accumulated in any way is the signal for a warning letter. A total of five points calls the driver for a conference with motor vehicle officials. Eight points result in a notice of suspension of the operator's permit to drive. The initial suspension period lasts from two to fifteen days. Subsequent suspensions are from fifteen days to ninety days, depending on the seriousness of the case.

When twelve points are accumulated in the driver's file, he loses his privilege of driving and his operator's permit is revoked. No points are kept on the driver's record for more than three years from

the date of the traffic offense. Thus the points accumulated for a traffic violation on a particular day will be removed from the total score three years later. No points are charged for any offense that occurred before April 1, 1953.

Educational Value of System

In the final analysis, the answer to traffic safety is said to lie in more and more safety education. The principal educational value of the point system stems from the three-point warning letter and the five-point personal conference. When the average person receives a letter telling him he has been assessed at least three points because of his potentially dangerous driving habits, it comes as quite a shock.

His attention is called to the fact that a check on his driving habits will undoubtedly eliminate the necessity for further warning. The letter is intended as a friendly suggestion that greater care may be necessary on his part if he is to drive safely and avoid losing his privilege of driving.

The five-point conference makes him further realize that our main objective is to encourage motorists to drive safely. It is not the department's policy to take away permits unnecessarily. We realize a person's operator-permit means a great deal to him. Our policy therefore is to permit him to drive as long as his record shows he is driving safely. The department has no alternative but to take his permit away when the record shows he is not a safe driver.

The letter calling him in for a personal conference is an additional factor in his progressive education and an additional warning since, in spite of the three-point cautionary letter, he has evidently been involved in a new violation and his record has now reached a serious stage. He is firmly impressed with the fact that if he continues to accumulate points against his record, it will soon reach the stage of suspension.

"I do not want this to happen," reads the conference letter, "as I am sure that your operator's permit means a great deal to you. Therefore you are being called to this office for a conference and a review of your driving record. It may not be necessary to take any action at this time but we do want to talk things over with you." The

letter is signed by the Director of Vehicles and Traffic and by the supervisor of the Driver Improvement Section.

After the conference, the driver has no comeback. If he acquires additional points to bring his total to eight, it is obvious he is the type of person who requires a more convincing argument to change his dangerous driving habits.

Before the point system, it was theoretically possible for a person to exclaim when notified that his permit was being revoked, "This is the first I've heard about it! I always thought I was a careful driver. Nobody ever told me I was a bad driver." Under the point system, that type of rationalization is no longer possible.

Points Permit Impartial Estimates

Department hearing officers have discretion in unusual cases to allow some leeway before ordering that a license be surrendered upon accumulation of a given number of points. Only points accumulated in a three-year period count against the driver's record. Each point is automatically erased when it becomes three years old, a procedure based on the theory that old records are not as important as new ones. The point system's three-year life tells driver-improvement officers how far back the driver's record is to be counted.

The weighted point system of screening records permits a fair and impartial estimate of the driver's traffic record without relying entirely on the judgment of a hearing officer.

In view of the hundreds of thousands of cases we are obliged to handle, it gives perhaps the closest and most flexible control of policy. The point system lists the specific conditions under which cases warrant special attention as soon as the police report form comes in. The weighted system of screening cases gives reviewing officers a fair scale of action to be taken and helps keep action uniform among the different reviewing officers.

However, the scoring system is not intended to make case review a mechanical job. Every driver is a human being, an individual with his own particular attitude toward driving. It is up to the hearing officer to determine, after hearing the driver's estimate of his traffic record, how best to help improve it. We know that the

success of our driver-improvement program is the result of careful, patient work on the part of reviewing officers. They decide what to do about drivers with bad records. If officers were not what they should be, our driver-improvement program would become nothing more than a clerical handling of cases, with probably little accident reduction. The point system is merely another method of accomplishing the aim of the law—to prevent bad drivers from making the road dangerous for others.

The fact that the point system grants authority to suspend or revoke does not mean it is department policy to take that action inexorably in every case that has accumulated eight or twelve points. Though the board of commissioners has granted the department that power, the actual practice is based on a wise use of this authority.

Five-Point Conference Aids Driving Habits

About two out of every fifteen drivers scheduled for conference fail to appear, with fewer than five percent failing to receive the call-in letter because of faulty address. Others have asked to be excused for business reasons, absence from the city, etc. Some have written arrogant letters or made arrogant phone calls refusing to appear for the conference. We feel that if we offer this opportunity and they fail to take advantage of it, nothing further should be done until the minimum number of points for suspension or revocation has been reached.

During the conference, the hearing officer explains how the point system functions, what it is trying to accomplish, exactly at what stage in the system the driver finds himself, and what will happen if he acquires additional points. The driver learns exactly what he can expect under the point system and what his rights are.

The hearing officer attempts to enlist the cooperation of the driver in finding out what is wrong with his driving. This very attempt to help will often of itself make him more conscious of safety in his driving and consequently a better driver. We solicit his cooperation in observing traffic regulations. We try to win from him voluntary acceptance of his social responsibility while sitting behind the wheel of a high-powered modern automobile.

The tenor of the interview is the offer to help the driver help

himself. The tone is friendly and constructive. However, the interview concludes with a strict warning that, if the driver returns in spite of this friendly and constructive talk, it will then be difficult for him to receive further sympathetic consideration of his case. Above all, says the hearing officer, the Driver Improvement Section must first consider the safety of the citizens of the District of Columbia and then the convenience of the driver. The department appreciates the importance of the permit to most drivers, many of whom require it in their work, but personal convenience must aways be secondary to public safety.

One hearing officer devised a simple but effective technique of imparting the importance of the permit to the driver. He opens his interview: "Do you have your operator's permit with you, sir?" When the driver answers affirmatively, he is asked to place the permit on the table before him. All through the interview, while the problems of driver responsibility and the safety of our citizens are being discussed in simple and friendly fashion, the permit lies on the table before him. It is a constant reminder that his repeated violations of the law may lose him his permit for a certain length of time.

A Hearing May Be Requested

When the driver has reached the stage of suspension or revocation, he is granted the opportunity of requesting a hearing within five days of receipt of the suspension notice. This hearing cannot be ignored. Failure to appear for the hearing cannot be used as a means of escaping loss of permit or as a technical means of temporary postponement. However, if the driver presents a good reason for failing to appear, the director will usually grant one continuance. If he should fail to appear the second time, his suspension is sustained.

The hearing officer averages about thirty hearings a day and it is interesting to note that three out of every ten drivers appearing will be accompanied by their attorneys.

Hearing officers point out that the primary purpose of the point system is to promote traffic safety. The suspension of the driver's permit is merely a means of achieving this end. When the driver enters the hearing room, the hearing officer immediately lays the ground work of psychological preparation for possible loss of the

driver's permit. He sketches in the larger problem of traffic safety. It is hoped the driver by that time will realize how seriously his violations have endangered public safety, and will anticipate the next step—the actual loss of the permit.

However, if he leaves the hearing room with his mind made up that we have merely penalized him, the hearing officer has failed in his mission. On the other hand, if the driver feels that in some small way we have helped him improve his driving habits, then the hearing officer has succeeded.

After finding out what is wrong with the driver's road behavior, the hearing officer can do one of two useful things without going so far as to take the driver off the road completely:

First, he may take away his privilege only under certain conditions by granting a restricted license. We have discovered that not all drivers are qualified to operate a vehicle anywhere, anytime. These restrictions prevent a driver from operating an automobile whenever certain peculiarities of his might cause trouble. They also help reduce the driver's exposure factor, so that his chances of having an accident are reduced.

These restrictions are useful in dealing with those not mature enough to be trusted with unlimited use of a car. They also taper off the use of cars by older people who no longer have the vitality to cope with heavy traffic in strange places. Yet both these types of driver need their vehicles to go to school, to help their parents, to carry on business or household affairs.

Second, the hearing officer may make an agreement with the driver not to suspend at eight but at nine or ten points. This gives him in effect another chance to show what he can do before the final step of suspension is taken. If he lives up to his agreement about behaving behind the wheel, he will no longer be so great a risk on the road. If he fails to do so, he confirms the fact that his driving habits justify protecting the public from him. Under the point system, the driver has been amply warned.

It is a disconcerting fact that many drivers who come to us as a result of violating traffic laws do not realize that records are kept of their driving violations. This in itself is a sobering realization for the driver and has a salutary effect. Another sobering thought is stressed by the hearing officer: "The automobile is potentially a deadly

weapon. It is not a plaything or a toy as some drivers' records seem to indicate."

Another by-product of the point system is the education of the driver to go to traffic court if he feels he was not guilty as charged by the traffic policeman. It also is educating the public to realize that payment of a forfeiture, regardless of the reason, is tantamount to admission of guilt. This has worked wonders in forestalling the common excuse that "I didn't know I was admitting guilt when I paid my collateral."

During the hearing, the driver's "conference sheet" is before the hearing officer. It gives a quick sketch of the driver for the officer's guidance in determining what action is necessary to make this particular individual a safer driver. For example, a note on his attitude during the conference will indicate whether or not a short period of suspension will be sufficient to make him realize the dangerous possibilities of his driving habits. It also helps to determine what approach must be adopted to win the driver's cooperation most effectively.

Suspension Emphasizes Responsibility

If the hearing develops nothing to mitigate his violations, then the driver is served with a suspension or revocation order which requires him to turn in his permit within three days. Of course, in the case of a court finding of driving while drunk in the District of Columbia, the issuance of a revocation order is mandatory. In such cases, the department has no discretion.

Experience shows that the loss of permit for even the minimum period of two days is important psychologically in getting over to the driver the fact that driving is only a privilege granted him which he may retain only so long as he does not constitute a danger or menace to other citizens.

When such a minimum period of suspension is imposed, it is hoped the driver will consider it not only a time without a permit but also time to reflect on the significance of his responsibility as a driver. Perhaps the chief reason drivers do the things that help cause accidents although they know better, is that they don't take the time to analyze their actions. The period of suspension may

cause the driver to reflect and conclude that his past behavior at the wheel was "asking for trouble" and that, sooner or later, would lead to an accident he could have avoided if he had observed the rules of the road.

The duration of the revocation period is neither fixed nor permanent. Reinstatement following revocation is never automatic. However, after six months following a revocation, the department will consider a new application. It is not required to act upon it favorably, however. For persons whose licenses have been revoked for dangerous driving habits, we require a special psychophysical examination. Often these new licenses are issued on a restricted or probational basis depending on conditions.

When the point system was established, the suspension or revocation of permits was not considered a punishment. Our attitude was that suspension or revocation was imposed in the interest of public safety. In other words, the action taken was not under judicial authority but as a simple administrative procedure. Consequently, it was theoretically possible for a permit to be suspended or even revoked after a full hearing of the facts even though no court action had yet been taken.

Points were assigned on the basis of police department reports of a violation, whether the case involved forfeiture of collateral, *nolle prosse,* no papers, or even findings of not guilty. It was the opinion then that each case should be judged according to factors which indicated danger to public safety. Too often it is possible for traffic cases to be thrown out of court on technical points of law. The mere fact that a case is thrown out on technicalities does not tend to make the driver any safer on the highway.

However, because of Judge David A. Pine's decision in the United States District Court for the District of Columbia dated December 5, 1953, this policy has changed. The court decision in a case involving the revocation of a permit restrained the District of Columbia "from revoking the permit of plaintiff unless and until an appropriate administrative tribunal of the District Government has made a finding, justifying it after fair hearing on reasonable notice, or unless and until plaintiff has been convicted in the Municipal Court of the charge there pending." As a result of this decision, no

points are to be assessed until final disposition of the case in court, whenever a court hearing has been requested.

The point system gives the department power to act quickly and effectively to protect the public from dangerous drivers. The law also provides against possible mistakes or misunderstandings by guaranteeing the driver a department hearing if he requests it within five days of receiving the notice.

Recognizing that the operating permit is a cherished possession of the average motorist, the District Board of Commissioners have set up a thorough appeals system from suspension or revocation decisions:

If the driver is not satisfied with the ruling of the hearing officer, he may request a review of his case by the director. If he is not satisfied with the director's ruling, he may request a review by the Board of Commissioners. If he is not satisfied with the decision of the Board of Commissioners, he may even appeal to the United States Court of Appeals for the District of Columbia. He may continue to drive until a ruling has been issued after a hearing on his case, except where revocation is mandatory, such as drunken driving.

The point system has created a great deal of interest. It has elicited much comment, practically all of it favorable. There have been some unfavorable comments, it is true, but the vast majority of the public appears to accept the point system for what it is, a system aimed at reaching the driver who commits traffic violations and winning his cooperation before it becomes necessary to suspend his operator's permit.

We in the department know that the point system has made an impact on the community. Every day we receive telephone calls from drivers wanting to know how many points they have and what they can do to keep from losing their permits.

The point system has evidently proved to be most effective in letting the driver know that his District of Columbia Government is watching his behavior on the road and is ready to do something about it if necessary. After almost a year's experience, we are convinced the point system is one of the most progressive and effective measures ever adopted to win the cooperation of drivers with poor and possibly dangerous driving habits.

Chicago's New Off-Street Parking and Loading Ordinance

EVERT KINCAID

Mr. Kincaid, consultant to the Chicago City Council Committee on Buildings and Zoning, and a member of the Board of Appeals, is president of the firm of Evert Kincaid and Associates. This firm has prepared comprehensive plans for Sterling, Rock Falls, Dixon, Moline and Westchester, Illinois, which are now in progress. Mr. Kincaid previously worked with the Federal Housing Administration, and later for the Chicago Plan Commission as executive director.

A MAJOR effort to stem the rising tide of traffic congestion in Chicago's streets was initiated on August 18, 1953 when this city's first comprehensive off-street parking and loading ordinance was enacted into law as an amendment to the Chicago Zoning Ordinance.

Previously, the zoning ordinance exercised no control over loading and unloading operations, and parking facilities were required for only a few uses—for theaters and other amusement establishments, and for apartment houses. The parking requirement for apartment houses, however, was declared invalid by the Circuit Court in 1952 on the grounds that the ordinance was discriminatory because it did not require other uses, permitted in apartment house districts, to provide parking facilities. Presumably the ordinance requirements for places of amusement would have suffered a like fate had they been contested.

The new off-street parking and loading ordinance is designed to be broad in scope and equitable in application. Under its terms, all uses generating automobile traffic are required to provide off-street facilities; uses that generate trucking must provide off-street loading and unloading berths. Parking and loading requirements apply chiefly to new buildings and new uses, but existing buildings and uses that undergo a substantial increase in scale of operation are subject to the requirements.

An existing apartment house, for example, which expands fifteen percent or more in number of dwelling units is required to provide parking facilities. Among other benefits accruing, it is hoped that this requirement will act as a brake on the trend toward conversion of large dwelling units into a number of smaller apartments with attendant overtaxing of existing public facilities and lowering of standards of safety and livability.

The parking and loading requirements apply to uses anywhere in the city of Chicago, except for the central business district where parking facilities are not required because of extremely high land costs and the feasibility of providing mass parking facilities through large public and private garages and parking areas.

Required Facilities Based on Use

Several indices of the need for parking and loading space, established in the new ordinance, form the basis for determining the quantity of required parking and loading facilities. Thus, parking requirements for residential uses are based on number of dwelling units, while for theaters seating capacity is used. Parking space for retail uses is computed on the basis of retail floor area; for manufacturing uses on the basis of maximum employment at a work shift. All loading space requirements are predicated on the amount of gross floor area, the most reliable index for this purpose.

Sample parking and loading requirements are shown in the following table:

Type of Use	*Required Parking Spaces*	*Required Loading Berths*
One and two family dwellings	One space per family dwelling unit.	———
Multiple Dwellings—Low Density	Spaces equal in number to 75 percent of bedroom apartments and 50 percent of efficiency apartments.	———
Multiple Dwellings—High Density	Spaces equal in number to 60 percent of bedroom apartments and 40 percent of efficiency apartments.	One berth for 50,000 to 200,000 square feet of floor area plus one berth for each additional 200,000 square feet.

Type of Use	*Required Parking Spaces*	*Required Loading Berths*
Hospitals	One space per 3 beds, plus one space per 10 daily visitors to out-patient facilities, plus one space per 1500 square feet of floor area in residents' quarters, plus one space per staff or visiting doctor.	One berth for 50,000 to 200,000 square feet of floor area plus one berth for each additional 200,000 square feet.
Retail Stores	One space per 300 square feet of floor area over 2,000 square feet.	2,000 to 8,000 square feet of floor area—one berth—10 x 25 feet. 8,000 to 25,000 square feet of floor area—one berth —10 x 45 feet. 25,000 to 40,000 square feet of floor area—2 berths—10 x 45 feet each. 40,000 to 100,000 square feet of floor area—3 berths—10 x 45 feet each. 100,000 to 250,000 square feet of floor area—4 berths—10 x 45 feet each. Each additional 200,000 square feet of floor area—one additional berth.
Manufacturing and Industrial Uses	One space for each 4 employees, based upon the maximum number employed.	2,000 to 40,000 square feet of gross floor area—one berth. 40,000 to 100,000 square feet of gross floor area—2 berths. Each additional 100,000 square feet of gross floor area or fraction thereof—one additional berth.

To expedite off-street parking, joint facilities for two or more uses are permitted if the facilities so combined would at least be equal to the sum of the separate requirements for each use.

Off-Site Facilities Permitted

The location of off-street parking facilities with respect to distance from the principal use served was an important consideration. Obviously, it would be desirable to have all accessory parking provided on, or contiguous to, the site of the principal use. Unfortunately this is not always possible, hence with the exception of low-density

dwellings where on-site parking is a reasonable requirement, off-site facilities must be permitted. Such off-site facilities, however, should be within a convenient walking distance of the principal use if they are to serve their purpose adequately. Surveys have consistently revealed drivers' reluctance to patronize parking facilities not reasonably close to their destination.

With these considerations in mind, the amendment established three walking distances for off-site parking facilities. Parking areas to serve apartment houses would be permitted to locate within 300 feet; certain other uses such as hospitals, sanitariums, lodging houses, and dormitories would be restricted to a distance of 500 feet; while the majority of uses, including retail, would be permitted to furnish required parking facilities within 1,000 feet, or approximately 1½ blocks, of the principal use.

In general, off-site facilities accessory to a principal use may be located in any other zoning district in which such use is permitted, including any less restricted district, but not in a more restricted district. Thus, a parking lot necessary to an apartment house can locate in an apartment or a business district, but not in a family, duplex, or group house district. This restriction may be modified by the Board of Appeals but in no case could parking facilities accessory to an apartment, business, or manufacturing use be permitted in a family or duplex district. However, parking facilities serving a main use in an industrial district are to be permitted in a manufacturing or commercial district.

The Board of Appeals may authorize the location, in an apartment district, of parking facilities accessory to a non-residential use in an adjoining district or to an existing professional or institutional office building. Such authorization would be contingent upon appropriate safeguards and conditions set forth in this amendment. This is designed to alleviate traffic congestion in business districts already developed in which there is an acute shortage of available space for transient parking purposes.

Parking Area Design, Uses, and Control

Ordinance standards governing the design of parking spaces and loading berths control the following:

1. Size and surfacing of parking and loading spaces;
2. Location of facilities with respect to street lines and required yards;
3. Means of access in relation to traffic movement;
4. Screening, landscaping and lighting.

In addition, accessory off-site facilities in residence districts would have to be open to the sky; garage structures for this purpose, a potential adverse influence to residential districts, would be prohibited.

These standards governing the manner in which parking spaces shall be designed and maintained should encourage the development of clean, efficient, and attractive parking facilities and should eliminate most of the objectionable features commonly associated with parking areas open to public view.

Automobile parking facilities developed as a business enterprise to cater to transient trade are treated as special uses, subject to review and determination by the Board of Appeals. Since these are not accessory facilities, special provision must be made for their location and operation.

In addition, the Board of Appeals will have jurisdiction over facilities developed for *existing* apartment buildings away from the site of the building served; except that open facilities can be developed as a matter of right on an adjacent lot or of course on the same lot with the main building.

To maintain the parking areas hereafter established under the ordinance, the following regulations shall apply:

The land upon which the parking facilities are located, or to be located, shall be in the same possession, either by deed or long term lease, as the property occupied by the use to which the parking facilities are auxiliary, in which case the owner of the land shall be bound by covenants filed on record in the office of the Recorder of Deeds or the Registrar of Titles of Cook County, requiring the owner, his or her heirs and assigns to maintain the required number of parking facilities throughout the existence of the principal use.

Before passage of the off-street parking and loading provisions, a number of months were spent in research and in conference with individuals and groups representing all phases of Chicago's civic and business activities. The Chicago Plan Commission and the Street Traffic Commission cooperated fully in securing data pertinent to the problem and in preparing the basic regulations. Support was also forthcoming from the parking and street traffic committees of the Association of Commerce, the Chicago Motor Club, the Back of the Yards Council, the American Institute of Architects, the Southeast Chicago Commission, the Housing and Redevelopment Coordinator, the Commissioner of Public Works, the traffic engineer and from others interested in relieving the congestion in Chicago's streets.

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